Conscientiousness, Health and Longevity: Exploring explanatory mechanisms

Antonia Elizabeth Wilson

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School of Psychology

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The candidate confirms that the work submitted is her own, except where work which has formed part of jointly-authored publications has been included. The contribution of the candidate and the other authors to this work has been explicitly indicated below. The candidate confirms that appropriate credit has been given within the thesis where reference has been made to the work of others.

Chapter 2 contains work which also appears in the publication titled 'Conscientiousness and fruit and vegetable consumption: exploring behavioural intention as a mediator', by Wilson, A. E., O'Connor, D. B., Lawton, R., Hill, P. L., and Roberts, B. W. in *Psychology, health & medicine*, in press (2015). The publication presents a jointly devised study, of which I conducted the data collection and data analysis. I drafted the paper, and each of the named authors contributed to the development of the written paper.

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ABSTRACT

Conscientiousness is positively associated with health and longevity. Evidence has suggested that conscientiousness can influence health via engagement in health behaviours. More recently, research has focussed upon alternative pathways through which conscientiousness may convey its desirable effects.

Questionnaire methods were utilised to examine the association between conscientiousness and health behaviours (study 1). Behavioural intention was explored as a mediator of the conscientiousness–fruit and vegetable consumption relationship, with results indicating that behavioural intention fully mediated the relationship. Conscientiousness was also shown to predict health behaviour guideline adherence, when health behaviours were examined independently and simultaneously (study 2). Findings indicated greater levels of adherence in individuals high in conscientiousness. Factor analysis revealed that the items employed to measure the facets of industriousness, order, self-control, virtue and traditionalism are reliable and represent separate lower order facets of conscientiousness. Meanwhile, the items employed to measure the facet of responsibility require revision.

Study 3 assessed psychological and physiological reactivity in response to stress in individuals with different levels of conscientiousness. Differential effects were seen between the conscientiousness groups, and primary appraisals were identified as being important for dealing with anticipated stress physiologically.

Daily diaries and multi-level modelling were employed to assess the effects of daily hassles on unhealthy between-meal snacking in individuals high and low in conscientiousness (study 4). An implementation intention based intervention was also delivered, and experimental condition and conscientiousness were assessed as moderators of the daily hassle–unhealthy snacking association. Conscientiousness was shown to moderate the relationship with a greater association seen between daily hassles and unhealthy snacking in individuals low in conscientiousness. Condition also moderated this relationship, with individuals assigned to the active control condition consuming fewer unhealthy snacks on more stressful days.

This thesis has provided evidence to support the roles of behavioural intention and stress in the conscientiousness-health association, and has highlighted multiple relations between these factors.

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LIST OF ABBREVIATIONS

ANCOVA - Analysis of Covariance
ANOVA - Analysis of Variance
BMI - Body Mass Index
BRFSS – National Centre for Chronic Disease Prevention and Health Promotion
CCS - Chernyshenko Conscientiousness Scales
CPT - Cold Pressor Test
DPB - Diastolic Blood Pressure
EMS - Eating Management Support Tool
HPA - Hypothalamus-Pituitary-Adrenal Axis
HR - Heart Rate
IND - Industriousness
MANOVA - Multivariate Analysis of Variance
MAST - Maastricht Acute Stress Test
NEO-PI-R - NEO Personality Inventory Revised
NHS - National Health System
ORD - Order
RESP - Responsibility
SAM - Sympathetic Adrenal Medullary Axis
SAS - Stressor Appraisal Scale
SBP - Systolic Blood Pressure
SC - Self-Control
SECPT - Socially Evaluated Cold Pressor Test
SES - Socio-Economic Status
SMS - Stress Management Support Tool
STAI - State-Trait Anxiety Inventory
STAI-6 - Six-item State-Trait Anxiety Inventory
STAR lab - Laboratory for Stress and Health Research
TPB - Theory of Planned Behaviour
TRAD - Traditionalism
TSST - Trier Social Stress
VHS - Volitional Help Sheet
VIRT – Virtue

Chapter 1

1 THE RELATIONSHIP BETWEEN CONSCIENTIOUSNESS, HEALTH AND LONGEVITY: A REVIEW OF THE LITERATURE

"The opposite of disease is not health"

Howard Friedman

Remarkably, conscientiousness can predict longevity (Kern & Friedman., 2008). In a fascinating study, Friedman et al. (1993) established that childhood personality was related to survival seven decades into the future. This astounding finding has attracted a great deal of interest over recent decades. Researchers from all over the world have become intrigued about what it is that conscientious people do that enables them to live longer lives. By understanding such behaviours, it is hoped that they may be translated to other less conscientious people to enable them to share the benefits currently experienced by those who are highly conscientious.

Within this chapter I will examine precisely what conscientiousness is, how conscientiousness is assessed, and explore its lower order structure. Moreover, I will consider the relationship between conscientiousness and longevity, the long-term applications of understanding this relationship and what factors can explain the conscientiousness-longevity relationship. In particular, I will focus on the role played by health behaviours and stress processes. Finally, the chapter will examine what methodologies can be employed to assess this relationship including new and innovative multi-level modelling techniques.

1.1 What is Conscientiousness?

Conscientiousness has been defined as the propensity to follow socially prescribed norms and rules regarding impulse control and to be goal directed, planful, and able to delay gratification (John & Srivastava, 1999), as well as, the propensity to be self-controlled, responsible to others, hardworking, orderly, and rule abiding (Roberts et al., 2009). The term conscientiousness is not new within the field of psychology and it is more widely known as part of the 'Big Five' taxonomy of broad personality traits,

commonly referred to as 'The Five Factor Model' (Costa & McCrae, 1992). Within this model, Conscientiousness, Openness, Extraversion, Agreeableness and Neuroticism are all named as dimensions within which human personality can be quantified. Personality has been described as an enduring characteristic, a manner of feeling, thinking, behaving, and relating to others (Segerstrom, 2000), with the fundamental difference between personality, mood and cognitions being defined through personality's stability over time. According to Roberts et al. (2014) "conscientiousness is most often thought of as a personality trait, which reflects the relatively enduring, automatic patterns of thoughts, feelings, and behaviors that differentiate people from one another and that are elicited in trait-evoking situations" (p. 2).

What is particularly interesting about conscientiousness, in comparison to other personality traits, is that it appears to have the most diverse and substantial effects in terms of life outcomes. For example, conscientiousness has been linked to longevity, marital success, educational success, occupational attainment, physical health, mental health and risk of injury (Judge et al., 1999; Hogan & Holland, 2003; Bogg & Roberts, 2004; Goodwin & Friedman, 2006; Wilson et al., 2007; Kern & Friedman., 2008). The capacity of conscientiousness to produce such wide and varying effects highlights its importance for life success. Not only is conscientiousness important for individual success, but possibly for society as a whole. If we can fully understand conscientiousness, then we may be able to utilise it. For example, 'increasing' conscientiousness may be a means of developing human capital and reducing financial burdens such as those faced by the National Health Service by promoting a more positive lifestyle. Although much is known about conscientiousness, there are many gaps in our understanding, some of which are outlined below and will be addressed in this thesis.

1.2 How is conscientiousness assessed?

Personality research is thought to date back to 1884 with Sir Francis Galton constructing 'the Lexical Hypothesis' (Atkinson et al., 2000), hypothesising that the language one adopts is an indicator of one's personality traits. Since this early theory, a large number of personality studies have been undertaken to produce a comprehensive model of personality. Five subsets of common personality factors have been identified by a number of independent researchers (Alport & Odbert, 1936; Catell & Marshall, 1957; Tupes & Christal, 1961; Norman, 1963; Costa & McCrae, 1976; Goldberg, 1990);

and these have become widely accepted within the field of personality psychology as Conscientiousness, Openness, Extraversion, Agreeableness and Neuroticism. Subsequently, in 1992 Costa and McCrae supported the use of the 'Five Factor Model' and devised a comprehensive measurement tool – the NEO Personality Inventory Revised (NEO-PI-R).

More recently, conscientiousness has been assessed in a number of different ways. The most popular measurement tool remains the NEO-PI-R (revised) (Costa & McCrae, 2008), alongside Goldberg's AB5C scales (Goldberg, 1999), the Hogan Personality Inventory (Hogan, 1992), the Jackson Personality Inventory (Jackson, 2004), the Multidimensional Personality Questionnaire (Tellegen, 1982), the California Personality Inventory (Megargee, 2008), and the Chernyshenko Conscientiousness Scales (Chernyshenko, 2002; Hill & Roberts, 2011; Green et al., 2015). The latter of which is the only scale that solely measures the personality trait of conscientiousness.

These measures vary in terms of the number of items employed and the type of method that they use. Methodologically, measurement tools can be classified as either lexical or statement. Within lexical measurements, individual adjectives reflective of conscientious traits are utilised, for example, the words 'organised' or 'prepared' are presented for participants to rate how well that adjective describes them as an individual. Measures employed by Saucier (1994) and Goldberg (1992) are examples of this method. Conversely, statement measurements ask participants to rate how well a statement describes them, for example 'I get into trouble because I act on impulses rather than on thoughts' or 'I would rather get a bad grade than copy someone else's homework and turn it in as my own'. This method is employed by scales such as the Chernyshenko Conscientiousness Scales (Chernyshenko, 2002; Hill & Roberts, 2011; Green et al., 2015).

Furthermore, these measures have the scope to be delivered in different ways. Conscientiousness is most often measured subjectively via self-report measures, though in some cases objective third party observer ratings and peer assessments have also been employed. Both methods of assessment have been shown to predict real life outcomes, such as longevity and health behaviours (e.g., Friedman et al., 1993; Bogg & Roberts, 2004). Another point to consider is that when assessing and quantifying conscientiousness, it is important to bear in mind that conscientiousness should be viewed on a continuum, and not something that can be regarded as categorical. Measurements of conscientiousness ought to include measures of characteristic

thoughts, feelings and behaviours as the inclusion of these three dimensions clarifies the argument that traits are not reducible to behaviour (Roberts et al., 2014), which has been a prevailing claim (Bandura, 2012; Jackson et al., 2012).

1.3 What is the lower order structure of conscientiousness?

Each of the 'big five' traits contain two dimensions. Firstly, the broad trait and secondly a number of lower order facets that are separate but correlated to the broader domain. For that reason, conscientiousness is not a single unified construct; rather an umbrella term to describe a conglomeration of constructs that are related and inter-linked, yet distinctly different. Precisely which lower order facets comprise the broad trait of conscientiousness has been deliberated over the past decade (Perugini & Gallucci, 1997; Saucier & Ostendorf 1999; Roberts et al., 2004; Roberts et al., 2005; De Raad & Peabody, 2005; De Young et al., 2007; MacCann et al., 2009; Jackson et al., 2010). Alongside this, the lower order facets have been labelled using a range of terminology which has led to difficulties in synthesising the structure of conscientiousness. However, what is agreed is that it is fundamental that the structure of conscientiousness is thoroughly understood if we are to make predictions and inferences based upon it.

Support for the classification of the lower order structure of conscientiousness arises for a number of reasons. Firstly, research findings have suggested that the lower order facets may be equal to or better predictors than the broad trait in some cases (Mershon & Gorsuch, 1988; Paunonen, 1998; Paunonen & Ashton, 2001). Secondly, there are possibilities for the lower order facets to demonstrate differential relationships to that of the broad domain (Roberts et al., 2005), and thirdly there are possibilities for the lower order facets to demonstrate differential relationships to each other (e.g., O'Connor et al., 2009). As Roberts et al. (2014, p.1) argue "our understanding of the relation between conscientiousness and important outcomes, such as health, longevity, and success in love and work, is only as sophisticated as our understanding of the construct of conscientiousness".

Based upon this notion, a number of researchers have identified the structure of conscientiousness in terms of its lower order assembly (Perugini & Gallucci., 1997; Saucier & Ostendorf; 1999; Robert et al., 2004; Robert et al., 2005; De Raad & Peabody., 2005; De Young et al., 2007; MacCaan et al., 2009; Jackson et al., 2010; Green et al., 2015). One problem that has arisen within this classification process is that a range of

terms have been employed to describe the same or very similar aspects of conscientiousness. For example, De Young et al. (2007) identified 'Orderliness', Robert et al. (2005) 'Order', Jackson et al. (2010) 'Organisation' and MacCann et al. (2009) 'Tidiness'.

In a bid to overcome this issue, comprehensive research from Roberts et al. (2014) identified the overarching themes generated from such studies, and placed each identified facet within them. The most common themes identified were Orderliness, and Industriousness, followed by Self-control and Responsibility. Less common themes identified were those of Traditionality, Decisiveness, Formality, Punctuality, Persistence and Virtue. The following facets were identified approximately six times in the eight studies listed above. *Orderliness* can be thought of as the extent to which a person requires organisation within their life, how tidy, neat and meticulous they are alongside a need for cleanliness as well as how prepared and planful they are. *Industriousness* can be described as how hard working and ambitious an individual is, how much effort they are willing to exert, having aspirations and a desire for excellence even when situations may be challenging ones. *Self-control* describes how much self-discipline and willpower one has, an ability to control impulsiveness, hot-headedness and recklessness. *Responsibility* refers to how dependable a person is and how likely they are to keep their promises and agreements. Responsibility also refers to the contribution an individual makes to their community and wider society in order for it to be of the highest standard possible. The remaining facets were identified in approximately two of the eight studies listed previously. *Traditionality* describes the extent to which one adheres to social rules, norms and conventions within a society. *Decisiveness* refers to consistently making firm and fixed decisions. *Formality* refers to following rules of 'correctness' such as being polite, having manners, and taking care of one's appearance. *Persistence* is how one perseveres in situations and continues to deliver until a goal has been completed. This has been considered perhaps as a sub-section of industriousness given that industriousness concerns overcoming challenges. *Punctuality* concerns turning up and turning up on time to agreed meetings. Recently, Punctuality has received more attention as a facet of conscientiousness (Roberts et al., 2014) given the finding that punctuality was most highly associated with the other potential facets of conscientiousness (Jackson et al., 2010).

1.4 What is the relationship between conscientiousness and longevity?

For most purposes, longevity is the single best measure of health (Friedman & Kern, 2014). Due to its validity and reliability (If death records indicate that someone is no longer alive, they usually aren't!) it is one of the most widely used measures of public health worldwide.

The aforementioned longitudinal study by Friedman et al. (1993) was conducted as part of the Terman Life-Cycle Study. Data collected from 1178 participants demonstrated that conscientiousness significantly predicted mortality rate when data collected from 1920 to 1986 was analysed. This effect has been confirmed by a collection of more recent studies (Iwasa et al., 2008; Terracciano et al., 2008; Taylor et al., 2009; Fry & Debats 2009; Chapman et al. 2010; Hill et al., 2011), with a meta-analysis producing a correlation of r = .11 (Kern & Friedman, 2008). One finding of this meta-analysis was that the odds of dying before 70 for someone who is on the 25th percentile or below on conscientiousness is about 35% greater than for someone who is on the 75th percentile or above.

A number of other studies have demonstrated conscientiousness as a predictor of longevity (Kern & Friedman., 2008). One recent large scale study conducted by Hagger-Johnson et al (2012) revealed that midlife conscientiousness levels were identified as an important risk factor for all-cause mortality. Over a mean follow up of 17 years, data from 6800 British participants demonstrated that a one standard deviation decrease in conscientiousness was associated with a 10% higher risk of all-cause mortality.

Other research has also demonstrated a positive association between longevity and conscientiousness in a variety of samples. Individuals experiencing renal failure were shown to live longer if they were rated as more conscientious (Christiensen et al., 2001), as did those suffering with coronary heart disease (Boyle et al., 2003). Members of a religious organisation displayed the relationship even when conscientiousness was measured in older age (Wilson et al., 2004). The association has also been observed in a heterogeneous sample of older age people living in various areas of the USA (Weiss & Costa, 2005), as well as in a sample of Scottish adolescents (Deary et al., 2008), and in a sample of individuals around 70 years old from Canada (Fry & Debats, 2009). Research from Roberts et al. (2007) demonstrated that the effect of conscientiousness on longevity was three times that of SES, which suggests that the relationship between conscientiousness and longevity is a profound one. Considering these findings, the

relationship between conscientiousness and longevity appears to be consistent, as well as present in a variety of contexts and age groups.

However, although the relationship between conscientiousness and longevity is well established, it is unclear whether different aspects of conscientiousness may be more predictive of health and longevity, which further supports the need to study conscientiousness at facet level. Furthermore, what is also less well understood are the pathways through which conscientiousness may exert its protective effects. Recent research has suggested that conscientiousness can influence health by 'implementation' factors or 'inoculation' factors (Hill et al., 2014). Implementation factors can be understood as the positive consequences of conscientiousness; whether psychological or social environmental in nature, which have a desirable impact on things such as health, educational success, marriage success, or job achievement. Conversely, inoculation factors can be understood as negative consequences that are avoided by more conscientiousness individuals, such as stress, divorce or counterproductive behaviours.

1.5 Long-term applications

The body of literature examining the relationship between conscientiousness, health and longevity has grown substantially over recent decades (Bogg & Roberts, 2004). The principle drive for research within this domain is to improve quality of life, health status and longevity. By studying individuals in terms of conscientiousness, it may be possible to understand how conscientiousness conveys its beneficial effects on health across the life course. As a result, this understanding could be used to inform interventions that aim to improve health status and health outcomes. In addition, vulnerable populations that require assistance in regards to their health could be identified as potential recipients of such interventions. Moreover, low conscientiousness may also serve as a risk factor or early marker of risk. If vulnerable populations scoring low in conscientiousness can be identified before the onset of ill health, there may be opportunities to intervene and reduce the effects of low conscientiousness on health outcomes and behaviours. Accordingly, this current research aims to examine the possible mechanisms through which conscientiousness may convey its desirable effects on health and longevity.

1.6 What are the mediators and moderators of the conscientiousness-longevity relationship?

A number of factors have been suggested as possible mediators and/or moderators of the conscientiousness–longevity relationship. These variables are wide ranging in terms of their aetiology, with biological, social and behavioural variables suggested.

A number of possible mediators of the conscientiousness-longevity relationship were explored in research by Hagger-Johnson and colleagues (2012). Socio-economic status (SES), social support, health behaviours, biological pathways and minor psychiatric morbidity were all examined. Results indicated only partial mediation for each mechanism, with adjustment for SES attenuating the association by 5%, health behaviours by 13%, cardiovascular risk factors by 14%, minor psychiatric morbidity by 5%, suggesting that a number of mediators explain the conscientiousness–longevity relationship.

One of the most popular and widely accepted explanations of the conscientiousness-longevity relationship comes from the consideration of the role of health behaviours (both detrimental and protective). Although it is known that the physical body degenerates naturally, this process can be enhanced by the way we live (Cassidy, 1999), in particular by the ways that we engage with health behaviours. The influential meta-analysis of 194 studies from Bogg and Roberts (2004) demonstrated that conscientiousness was positively correlated with physical activity; and negatively correlated with excessive alcohol use, unhealthy eating, tobacco use, drug use, risky driving, risky sex and suicide.

More recently, longitudinal research has supported the findings of Bogg and Robert's (2004) review. In a large scale study of 1054 participants, the mechanisms through which childhood personality traits influence health status in adulthood were assessed via longitudinal data spanning forty years (Hampson et al., 2007). Results indicated that conscientiousness influenced health status in adulthood indirectly via educational attainment, healthy eating habits and smoking. Likewise, in a similar study, longitudinal data for 1253 participants was assessed over seven decades, from 1930 to 2000 (Martin et al., 2007). The study aimed to address whether personality in childhood and adulthood were independent predictors of morbidity risk, and the extent to which this relationship was accounted for by behavioural and psychosocial variables. Results revealed that childhood personality and adult personality were in fact independent

predictors of mortality. Further analysis indicated that the relationship of adult personality with mortality, but not childhood personality, were mediated by health behaviours such as smoking and alcohol consumption. Additionally, conscientiousness has recently been related to other health behaviours such as medical adherence, which has been shown to be positively associated with conscientiousness (Hill & Roberts, 2011; Molloy et al., 2014).

These findings offer a possible explanation for increased longevity - that conscientiousness is associated with a healthier lifestyle, which in turn has a direct impact upon physical health. 'In very simple terms, the better we care for the body we have, the longer we will have it' (Cassidy, p.4). However, although the relationship between conscientiousness and health behaviours is robust and replicable, longitudinal research suggests that health behaviours may only partially explain the conscientiousness-longevity relationship (Friedman et al., 1995; Kern & Friedman., 2008). Alternative mechanisms that have been offered include the notion that conscientiousness may interact with other personality traits in an attempt to manage any undesirable effects produced by other personality traits (e.g., neuroticism may generate anxiety), as well as enable an individual to employ effective coping strategies. For example, a number of studies have demonstrated the ability of conscientiousness to reduce emotionality and anxiety (Terracciano & Costa 2004; Chapman et al., 2011b; Turiano et al., 2013). Similarly, more conscientious individuals may employ more useful coping strategies when facing emotional situations and experiencing anxiety, and thus are better able to control their emotions and handle the situation. One study supporting this notion conducted by Javaras and colleagues (2012) demonstrated that conscientiousness was able to predict recovery from negative emotional challenges.

Another important factor to consider when discussing the possible mediators and moderators of the conscientiousness-longevity relationship is that individuals high in conscientiousness may experience different living environments and situations which may in turn have a positive impact upon their health status. On the positive end of the spectrum, highly conscientious individuals are more likely to have a higher education, successful career, and higher salary – factors which are all correlated with health and longevity (Roberts et al. 2003; Hampson et al. 2007, Ozer & Benet-Martinez 2006, Poropat, 2009). Similarly, highly conscientious individuals are more likely to maintain successful marriages, and have fewer incidents of divorce (Cramer, 1993; Kelly & Conley, 1987; Tucker et al., 1998); which is important considering the finding that being married

may have protective effects in that spouses' levels of conscientiousness were found to predict their partners' health outcomes over their self-ratings of conscientiousness (Roberts et al., 2009). Similarly, individuals who are more conscientious have been shown to belong to more organisations and clubs (Lodi-Smith, 2007) and have more social support in adulthood (Roberts et al., 2009).

A number of demographic variables have also been associated with conscientiousness. First, conscientiousness has been linked to education, with higher educational level positively associated with conscientiousness (Noftle & Robins, 2007). Moreover, conscientiousness has been shown to predict health status via its relationship with educational attainment, which is often, interlinked with socio-economic Status (SES) (Lodi-Smith et al., 2010). Second, gender has been associated with conscientiousness with males appearing to be less conscientious than females (Vollrath et al., 2012). Lastly, age has been shown to be associated with conscientiousness, with levels of conscientiousness increasing over time (Caspi et al., 2005; Gartland et al., 2012); with the possibility that the lower order facets of conscientiousness may increase with age at different rates. In addition, particular facets of conscientiousness may be more relevant at different time points throughout life. For example, when at school one may be faced with activities that require high levels of industriousness, but responsibility may be less important. During working life, one may be required to possess high levels of order to enable the management of workload and family responsibility. In later life industriousness may become less important. Therefore, it seems that a vast array of factors may contribute to the understanding of the conscientiousness-longevity relationship.

However, it has been argued by Luo and Roberts (2015) that previous research has largely focused upon implementation factors, i.e., the positive consequences associated with conscientiousness, with few studies focusing upon inoculation factors, i.e., the avoidance of behaviours that have a negative impact.

1.7 The role of stress in the conscientiousness-longevity relationship

One inoculation factor that has been proposed as a moderator of the conscientiousness-longevity relationship is stress (Friedman, 1993). Stress is a term that is heard frequently in everyday life; yet there is still much debate around the way that stress is conceptualised. Providing a single and universal definition of stress has proved to be somewhat problematic, with a number of varied and dissimilar definitions of stress

available. For example, stress has been described as ‘external events or conditions that affect the organism’ (Breznitz & Goldberger, 1993, p. 3), ‘to subject (a material thing, a bodily organ, a mental faculty) to stress or strain; to overwork, fatigue’ (Butler, 1993, p.1) as well as ‘a particular relationship between the person and the environment that is appraised by the person as taxing or exceeding his or her resources and endangering his or her well-being’ (Lazarus & Folkman, 1984, p. 19). These wide-ranging and varying definitions have lead researchers to study different aspects of stress, with some researchers focusing upon the psychological aspects of stress, whilst others have focussed upon physiological aspects. Within this current research, both the psychological and physiological aspects of stress will be assessed.

There is a large body of literature investigating stress and its outcomes, and it is now well established that the experience of stress is associated with a number of detrimental physical health outcomes. Stress has been shown to be associated with the development of disease, such as hypertension, cardiovascular disease, cancers, HIV/AIDS and immune system suppression (Cohen et al., 1993; Kiecolt-Glaser et al., 1995; Cohen et al., 1998; Kulkarni et al., 1998; Segerstrom & Miller, 2004; Reiche et al., 2004; Hamer & Malan, 2010;) as well as with psychological health, such as depression (Hammen, 2005) and anxiety (Dyson & Renk, 2006). One meta-analysis conducted by Segerstom and Miller (2004) found that over 300 studies had been conducted examining the relationship between stress and immune system functioning over the previous thirty years, with results showing that psychological challenges had the ability to modify aspects of immune system responses. Therefore, although these relationships are fairly complex, they appear to be robust and reputable.

One possible way in which stress may cause such disadvantageous effects on physical health is via allostasis. Allostasis has been described as maintaining stability of bodily systems through physiological or behavioural change (Sterling & Eyer, 1988), and is used to describe how physiological systems react to changes within the body; with the view that allostasis is ordinarily adaptive in the short term (McEwen & Wingfield, 2003). The concept of allostasis can be applied to a number of physiological systems, for example, the cardiovascular system, but most importantly in this context, to the stress systems. Specifically in relation to the SAM and HPA axes systems, the term allostatic load has been used to describe the ‘wear and tear’ that is endured by the stress system as a result of repeated activation, i.e., repeated allostasis; alongside the inefficient

activation of the system (McEwen et al., 1998; Seeman et al., 2001; Logan & Barksdale, 2008).

It has been proposed by McEwen and Wingfield (2003) that there are two different ways in which allostatic load can occur. Firstly, allostatic load can occur when energy demand exceeds supply. In this case, glucocorticosteroid levels in the blood increase, which lead to physiological and behavioural changes that ensure that the individual has sufficient energy available to them, allowing the individuals to cope with the situation. Secondly, allostatic load can occur when there is sufficient or excess energy accompanied by social conflict or social dysfunction. As a result, levels of glucocorticosteroids become present within the blood. For this type of allostasis escape from allostatic load is only achievable when the person changes their behaviour and/or escapes the negative social situation.

Research has suggested that the relationship between stress and health may be moderated by personality factors (Lou & Roberts, 2015). It has been proposed by Segerstrom (2000) that 'due to its consistency, personality has the potential to have an enduring influence on physiological systems and health' (p.1). For instance, research by Segerstrom (2000) revealed that personality dimensions are related to immune parameters or immunity. Relatedly, it has been suggested that there is consistency in the way in which individuals typically respond to a variety of stressors, which has been termed 'response stereotypy' (Lacey & Lacey, 1958), a concept that reflects the consistent effects of personality on behaviour. Therefore, it is seems that personality has the potential to either predispose or protect an individual against the negative health outcomes associated with stress; both over a wide range of situations and over extensive periods of time.

Research has shown that personality plays an important role in nearly all aspects of the stress process. Personality has been associated with the likelihood of experiencing stress (Bolger & Zuckerman, 1995), the evaluation of an event as being stressful (Gunthert et al., 1999), coping strategies employed in response to a stressful event (Watson & Hubbard, 1996) as well as the ability to overcome a stressor (Bolger & Zuckerman, 1995).

Although stress has not been widely investigated in relation to the conscientiousness-longevity relationship, conscientiousness has been shown to be associated with stress and health. One study following the progression of HIV disease over a one year period demonstrated that conscientiousness was able to predict an

increase in CD4 cell counts (an important immune parameter) and a decrease in viral load at one year follow up (O'Cleirigh et al., 2007). Alongside this, it was found that not only was perceived stress negatively associated with conscientiousness, but that perceived stress mediated the relationship between conscientiousness and HIV progression. Furthermore, no other mediators were identifiable. More recent research (Lou & Roberts, 2015) examining the relationship between conscientiousness, perceived stress and perceived physical health demonstrated that stress mediated the association between conscientiousness and perceived physical health. Furthermore, this study also showed that changes in conscientiousness were associated with changes in stress. Therefore, these findings provide support for the notion that stress mediates the conscientiousness-physical health association.

As outlined earlier, a framework for studying personality in the stress process has been offered by Bolger and Zuckerman (1995). Within this framework (see Figure 1) it is postulated that personality has the potential to influence both exposure to stressful events and reactivity to stressful events, and that it is via both of these processes that the effects of personality on health outcomes can be explained. In addition, the framework stipulates that personality related variations in reactivity may arise from differences in coping efforts and the effectiveness of such coping efforts. Although Bolger and Zuckerman applied this framework to the personality dimension of neuroticism (1995), the framework is applicable to other personality dimensions, and consequently provides a valuable starting point to further examine the relationship between conscientiousness and stress. Therefore, this framework will be utilised within this thesis. Moreover, stress exposure and stress reactivity (both in terms of psychological and physiological stress) will be examined within this current research.

1.7.1 Exposure to stress

In accordance with the framework produced by Bolger and Zuckerman (1995) (Figure 1.1) exposure to stress has been examined in relation to conscientiousness. Indeed it has been shown that conscientious individuals may encounter lower levels of exposure to stress, in particular via the experience of a fewer number of daily stressors, which in turn may lead to less activation of biological systems and better health (McEwen, 1998; Vollrath; 2000; O'Connor et al., 2009). Furthermore, exposure to stress has not only been studied in terms of numbers of stressors, but also in terms of

perceived stress, with a variety of studies demonstrating that conscientiousness is negatively associated with perceived stress (Penley & Tomaka, 2002; Lee-Baggeley et al. 2005; Bardi & Ryff, 2007; Besser & Shackelford, 2007).

Conversely, it has been seen that conscientiousness can be related to greater levels of stress. In a study conducted in Norway (Tyssen et al., 2007), personality types were examined as predictors of stress experienced during medical school training. Results revealed that conscientiousness was an independent predictor of greater levels of stress. The authors concluded that individuals high in conscientiousness were at risk of experiencing more stress, whilst individuals low in conscientiousness were protected against stress. Although this finding conflicts with the findings of previous studies, there may be plausible explanation. In some cases, perceiving high levels of stress may be advantageous. By recognising the extent of the demands placed upon them, an individual may be better equipped to overcome and/or cope with the stressor. Given that this research was conducted within the unusual setting of a medical school, it is likely that experiencing elevated levels of stress may have assisted the students to meet the demands placed upon them by encouraging them to complete their goals, which as a result may diminish the stress that they had experienced. Notably, this study highlights that the type of stress and context of stress is particularly important.

When discussing stress in terms of quantity of stress, it is important to acknowledge that individuals may appraise stressful situations differently, that is to say, people may find the same 'stressors' more or less stressful than other people (Smeets et al., 2012). The way in which stressors are evaluated has been studied closely, and as a result, it has been hypothesised that one way in which conscientiousness may convey its beneficial effects on health is through the cognitive appraisals of stress (O'Connor et al., 2009).

Cognitive appraisal can be defined as 'a process through which the person evaluates whether a particular encounter with the environment is relevant to his or her well-being, and if so, in what ways' (Folkman et al., 1986, p. 992). The transactional model of stress (Lazarus & Folkman, 1984) suggests that there are two types of appraisal: primary and secondary. In primary appraisal, the individual assesses whether they have anything at stake in the situation by evaluating the significance of the stressor, the risk involved and the demands and challenges that the situation presents. For example, whether there is a possibility of experiencing benefits or harm as a result

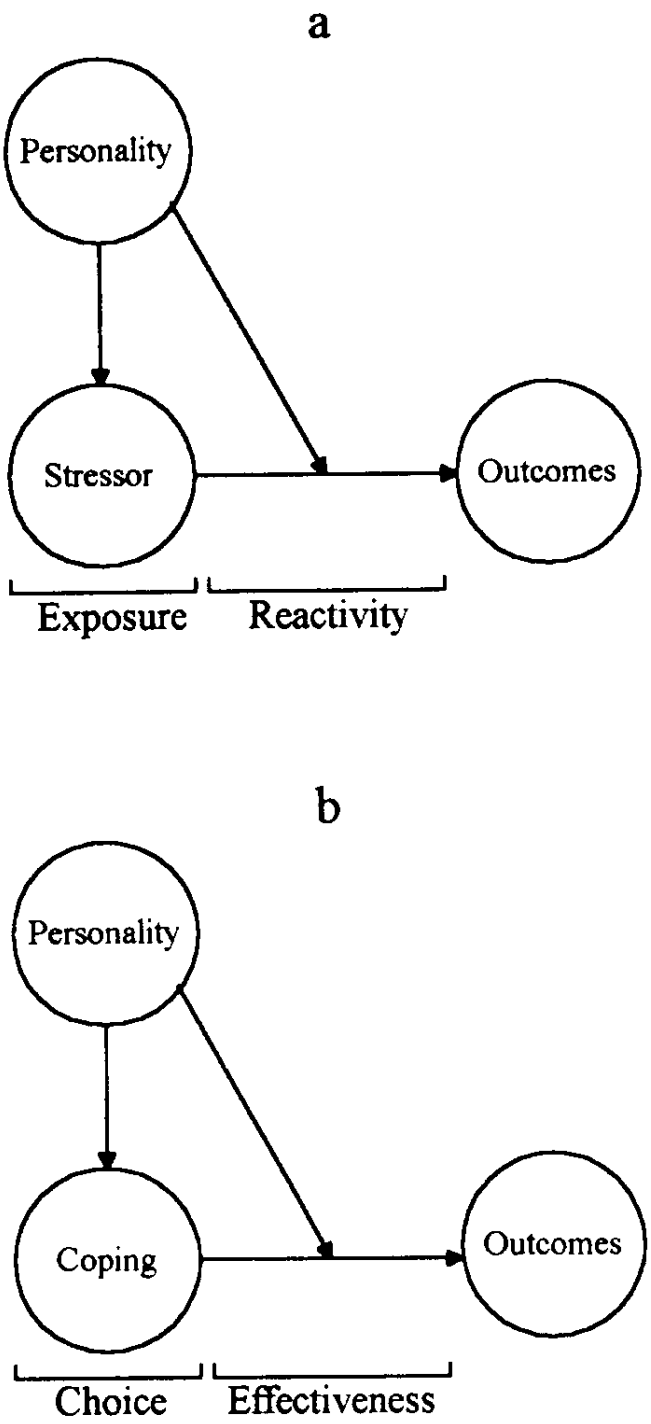

Figure 1.1. A general framework for linking (a) personality to exposure and reactivity to stressors (b) personality to components of reactivity: coping choice and coping effectiveness (Bolger & Zuckerman, 1995)

of the encounter. In secondary appraisal, the individual assesses whether anything can be done to affect the prospect of benefit or harm by evaluating the level of control that they hold over the situation; as well as by evaluating what resources they perceive to hold and whether they are able to influence the outcome of the situation. For example, whether a coping strategy can be employed to overcome the situation, or whether the situation should simply be accepted. Therefore, this evaluative process works to produce cognitive representations of a stressor, and determines how a person feels, thinks and controls the encounter at hand.

According to Lazarus and Folkman's (1984) transactional model of stress, when demands perceived outweigh resources, an individual will experience the feeling of threat. On the other hand, when the necessary resources required to overcome demands are perceived to be available, an individual will feel challenged. Therefore, it is not to say that the person will not feel any emotion if they are able to cope with the situation, but that the emotions experienced will differ.

Individuals may appraise situations differently dependent upon their level of conscientiousness. Research conducted by Gartland et al. (2012) investigated the relationship between conscientiousness and cognitive appraisal of daily hassles. Findings revealed that individuals with high levels of order and industriousness had a greater stake in their hassles compared to individuals with lower levels of order and industriousness, whilst individuals high in responsibility reported themselves as being able to cope better than those individuals low in responsibility.

Similarly, when Penley and Tomaka (2002) examined the appraisals of participants who were required to prepare and deliver a public speech, it was seen that the appraisals of participants scoring high in conscientiousness were negatively associated with task demand and threat, whilst positively associated with a higher perception of ability to cope alongside higher perceptions of responsibility for the task. Subsequently, it seems that appraisals can indeed be influenced by conscientiousness and that this relationship can be observed in both naturalistic and laboratory based settings. However, more research assessing the appraisals of variety of stressors in a variety of contexts is desirable to further establish the precise relationships between appraisals and conscientiousness.

1.7.2 Reactivity to stress: Coping

Alongside exposure to stress, the framework proposed by Bolger and Zuckerman (1995) (Figure 1.1) hypothesised that personality may have the capacity to influence reactivity to stress. Reactivity to stress can be understood in more than one way. To begin with, reactivity to stress can be of a psychological, behavioural or physiological nature, and relatedly, stress can have both a direct and indirect effect on health. This current section discusses reactivity to stress in terms of psychological and behavioural reactivity, whilst physiological reactivity is discussed in the successive section.

There are individual differences in the ways people cope and handle stress. To begin with, it is postulated that the ways in which people respond to stress may vary dependent upon level of conscientiousness. For example, individuals high in conscientiousness may be able to cope with stress better (Bartley & Roesch. 2011). The main focus of research within this area has been on the employment of varying types of coping skills in response to stress, with a range of studies having investigated coping ability and style in relation to personality variables (Penley & Tomaka, 2002; Connor-Smith & Flachsbart, 2007). In most instances, high conscientiousness has been found to be associated with proactive and beneficial coping styles, alongside greater perceived coping ability in the face of stress exposure. This notion has been supported by the aforementioned research by Penley and Tomaka (2002) which indicated that conscientiousness was positively correlated with perceived coping ability alongside perceived responsibility for and control over the situation.

Other research has suggested that conscientious individuals are able to cope better with stressful situations as they find them less demanding than their low conscientious counterparts (Connor-Smith & Flachsbart, 2007). A meta-analysis by Connor-Smith and Flachsbart (2007) demonstrated that conscientiousness is specifically related to the employment of specific coping strategies. Conscientiousness was shown to be positively associated with the use of approach style behaviours such as problem solving, cognitive restructuring, emotional social support, instrumental social support, and emotion regulation (Connor-Smith & Flachsbart; Roesch, et al., 2006; Vollrath & Torgersen, 2000; Bartley & Roesch., 2011); whilst negatively associated with avoidant style behaviours such as denial, negative emotion-focused, avoidant coping, and substance use as forms of coping (Connor-Smith & Flachsbart; Saklofske et al., 2007).

Furthermore, research from O'Brien and DeLongis (1996) demonstrated that individuals who were high in conscientiousness employed less escape-avoidance and

self-blaming strategies, when assessed over a range of situations. Alongside this, the authors concluded that individuals high in conscientiousness employed more problem-focused coping, which was shown to be effective if the individual perceived control over the situation. This finding has also been supported by research from Bartley and Roesch (2011) who found that individuals higher in conscientiousness used more problem-focussed coping. It has been suggested that differences in coping style and coping strategies may be due to the way in which stressful situations are appraised (O'Brien and DeLongis., 1996). These differences in appraisals may be due to situational characteristics as well as the individual's characteristics. However, contrary to this argument, research from Shewchuk et al. (1999) suggested that individuals high in conscientiousness utilised more instrumental, proactive coping styles, regardless of how the stressor was appraised.

Therefore, conscientiousness seems to be associated with approach style coping strategies, which have a largely problem-focused based nature. It is therefore possible that individuals low in conscientiousness may not be able to successfully manage stressful situations to the same extent as their counterparts, and as a result may not be able to successfully reduce the stress that they are experiencing. Therefore, this offers a possible mechanism via which low levels of conscientiousness may be translated into poorer health. In other words, the 'direct' impact of the inability to reduce stress may lead to increased allostatic load, which over time may have deleterious effects on physical health.

Relatedly, as a consequence of ineffective coping with stress, individuals low in conscientiousness may employ alternative methods to alleviate the negative emotion triggered by stress. For example, they may be more likely to engage in unhealthy behaviours as a coping strategy, which then contribute to health problems over the lifespan. Thus, this notion offers an alternative mechanism through which low levels of conscientiousness may be translated into poorer health, i.e., via an 'indirect route'. Although this mechanism has not been researched as widely as the 'direct' route, there is some support for this premise. Research by O'Connor and O'Connor (2004) was able to demonstrate that in the face of a stressful encounter, individuals low in conscientiousness were less able to cope with the encounter, and this resulted in an increased preference towards highly palatable and energy dense foods.

Likewise, research by O'Connor et al. (2009) investigated the effects of daily hassles on health behaviours and assessed conscientiousness as a moderator of this

relationship. Results indicated that daily hassles were positively associated with unhealthy eating behaviours, caffeine intake, and smoking (in smokers), whilst negatively associated with alcohol intake, vegetable consumption and physical activity. Additional analysis revealed that lower order facets of conscientiousness moderated this relationship, in that those who scored low in conscientiousness were more likely to engage in unhealthy behaviours as a coping strategy in response to stress. Further support comes from the study conducted by Gartland et al. (2013). Within this research, the authors investigated the moderating effects of conscientiousness on daily hassles – mood relations. Findings indicated that total conscientiousness as well as two lower order facets of conscientiousness moderated the relationship between stress appraisals and daily affect. Therefore, it seems that conscientiousness may exert some of its influence on physical health via the modification of the effects of daily hassles.

Remarkably, it is possible that the modification of health behaviours as a means to reduce stress can in fact increase activity within the physiological stress system. One health behaviour that may be altered as a result of stress is alcohol intake. Studies have indicated that alcohol is consumed as a means of coping with stress, with one such study, (Abbey et al., 1993) demonstrating that drinking alcohol to cope with stress significantly interacted with perceived stress. Independently, research investigating alcohol intake alongside stress has found that alcohol consumption can in fact activate the HPA axis and thus elevate glucocorticoid levels (Spencer & Hutchinson, 1999). Considering these findings together, it therefore seems that a person may consume alcohol as a means of dealing with the negative effects of stress in a bid to overcome them, but in fact further stimulate the already aroused stress system; thus producing increased load on the physiological system. Furthermore, given the finding that conscientiousness is negatively correlated to alcohol intake (Bogg & Roberts, 2004), individuals low in conscientiousness may be particularly vulnerable to this process.

Together, this evidence portrays a picture of individuals high in conscientiousness as persons who employ effective coping techniques and respond to stressful situations in appropriate ‘stress reducing’ ways, which in turn reduces increased wear and tear on their physiological stress systems. Subsequently, they may not feel the need to engage with alternative coping mechanisms to relieve the negative feelings associated with stress, such as unhealthy eating behaviours or alcohol consumption. Consequently, the stress endured does not influence health indirectly via the modification of health behaviours.

1.7.3 Reactivity to stress: Physiology

It has been postulated that there may be individual variability in regards to physiological reactions to stress, with some evidence indicating that these variations in reactivity are associated with personality variables. Investigating this relationship, Jorgensen and Houston (1986) examined whether personality characteristics alongside family history of hypertension were associated with excessive cardiovascular activity. Results indicated that individuals who had both a family history of hypertension and who presented the personality characteristics of denial, neurotic feelings or aggressiveness, when compared to those without such characteristics, exhibited greater systolic and diastolic blood pressure responses during stress periods.

Similarly, research assessing the effects of anxiety and defensiveness on blood pressure reactivity in response to a mental challenge found that individuals scoring low on anxiety and high on defensiveness, who were labelled as 'repressive copers', were found to show greater systolic blood pressure reactivity in comparison to groups with differing combinations of anxiety and defensiveness levels (King et al., 1990). Likewise, Lyness (1993) considered differences in blood pressure reactivity in relation to Type A and Type B personalities. Type A personalities can be described as those in which competitive, aggressive and hostile behaviours are seen alongside a sense of time urgency. In contrast, Type B personalities refer to the opposite end of the spectrum, with such personalities reflecting a lack of Type A characteristics, with relaxed and easy going qualities. Results of the investigation revealed that as hypothesised, individuals classified as having Type A personalities demonstrated greater systolic, diastolic and blood pressure reactivity in a variety of situations, including those which involved negative feedback evaluation and included socially aversive elements.

Alongside blood pressure reactivity, research has investigated the effects of personality on heart rate reactivity and recovery. In a study examining the effects of individual differences on heart rate reactivity and recovery in response to a laboratory based stressor, it was demonstrated that prolonged heart rate recovery was associated with Rehearsal (a concept similar to rumination in which individuals rehearse emotional events) and Benign Control (a concept similar to self-control) (Roger & Jamieson., 1988). In a second study, Roger (1988) examined urinary cortisol in a sample of nurses who were completing an important written examination. Here, results indicated that again Rehearsal was an important associate of the stress response, with rehearsal significantly positively associated with cortisol levels. However, studies have generated mixed results

relative to the cortisol-personality relationship. Utilisation of the Trier Social Stress Test (TSST; Kirschbaum et al., 1993) was found to significantly increase cortisol activity; however no personality variables were found to be significantly associated with this relationship (Kirschbaum et al., 1992).

Although conscientiousness has not been widely investigated in relation to the physiological responses associated with stress, there is some support for its association. Research conducted in Poland by Merecz and colleagues (1999) investigated the effects of each of the big five personality factors as modifiers of cardiovascular responses to occupational stress. Results revealed that conscientiousness was the only personality factor that modified the cardiovascular response to occupational stress, when measured in terms of systolic blood pressure reactivity. Further analysis also suggested that low levels of conscientiousness were associated with increased heart rate reactivity when the participant was at the workplace. However, the authors concluded that conscientiousness, alongside the other personality variables studied, was not found to be particularly sensitive to the level of occupational stress reported.

One other study that has included conscientiousness assessed the relations between personality variables, affect and cortisol activity over a six day period. Conscientiousness was not found to have a main effect on cortisol levels, but differences were observed between individuals high and low in conscientiousness, in that those who were high in conscientiousness exhibited lower levels of cortisol in response to positive affect (Nater et al., 2010).

More recently, conscientiousness was assessed in relation to a naturally occurring stressor. Within this research, Garcia-Banda et al. assessed cortisol levels as an indicator of physical stress over a stress day and a control day. Results indicated that there was a significant effect of conscientiousness on stress reactivity, with greater levels of cortisol associated with high levels of conscientiousness (Garcia-Banda et al., 2011).

Additional research assessing the effects of conscientiousness on heart rate showed that when faced with stressful tasks, individuals high in impulsiveness (an aspect of the self-control facet) showed more elevated heart rate reactivity compared to those who were less impulsive (Heponiemi, 2004). However, contradictory research from Allen et al. (2009) demonstrated that individuals high in impulsiveness showed a lesser increase in heart rate reactivity compared to those with higher levels of conscientiousness. Nonetheless, each of these studies suggest that personality, and

more specifically conscientiousness, may play a significant role in the physiological responses to stress. However, given that there is relatively little research examining the relationship, one aim of this current research is to further examine the conscientiousness-stress reactivity relationship.

1.8 Methodologies

1.8.1 Laboratory Stressors

Stress related research has utilised stress eliciting procedures as a means of generating measurable physiological responses to stressors. Although stress is a process that usually occurs in naturalistic settings, it is extremely difficult to measure physiological responses to such stressors due to the small window of time in which these responses can be seen. Therefore, a number of protocols have been designed to activate the stress system within laboratory settings, to enable such physiological responses to be measured immediately following the system activation.

To date, the most popular stress induction procedures are the Trier Social Stress Test (TSST; Kirschbaum et al., 1993) and the Cold Pressor Test (CPT; e.g., Lovallo, 1975; Mitchell et al., 2004; Smeets et al., 2012). Firstly, the Cold Pressor Test is a test that is physical in nature. The procedure requires participants to immerse their hand into ice-cold water (typically 0-5 degrees Celsius) for a number of trials lasting up to a maximum of three minutes long, whereas dissimilarly, the Trier Social Stress Test is a test that is psychological in nature, and requires participants to deliver a five minute long speech (for example, an imitation job interview) in front of a panel of 'experts', as well as perform mental arithmetic for five minutes in front of an audience, whilst being audio and video recorded. Both procedures have been shown to elicit acute stress responses; however, the procedures have been shown to activate different aspects of the stress system to different extents (Smeets et al., 2012); suggesting that type of stressor may influence physiology in different ways. More recently, aspects of these two procedures have been combined to create the Maastricht Acute Stress Test (MAST; Smeets et al., 2012), and thus a procedure that includes both physical and psychological components, however, it does not require use of an 'expert' panel. Testing of this protocol has revealed that the procedure has the capacity to produce activation that is equivalent to the Cold Pressor Test in some domains of the stress system (the SAM axis) and greater activation in other domains (the HPA axis). Meanwhile in comparison to the Trier Social

Stress Test, activation produced by the MAST was similar in both domains (SAM and HPA axes). The MAST procedure therefore has the ability to activate both the SAM and HPA axes of the stress system, which are known to have differential effects on physiology, whilst comprising both physical and psychological aspects of stress (Smeets et al., 2012).

Employment of these methods allow for physiological responses to be measured in terms of blood pressure, heart rate and hormonal activity (for example, through cortisol and salivary alpha-amylase); as well as via the measurement of subjective or perceived stress in response to the procedures. Results of the research conducted by Smeets et al. (2012) revealed that employment of the MAST procedure was able to elicit strong autonomic and glucocorticoid stress responses. When compared to responses yielded by the CPT, the MAST was found to elicit superior salivary cortisol responses and equivalent blood pressure reactivity and perceived stress responses. In comparison to the TSST, results revealed similar levels of activation for all domains examined. The MAST was therefore concluded to be successful in eliciting subjective, autonomic and glucocorticoid stress responses.

However, research in the field of stress has been criticised for being overly reliant on the employment of laboratory stress procedures as a means of measuring stress (O'Connor et al., 2008); as they as they do not permit for fluctuations in 'real-life' stress to be examined. Although laboratory based stressors are a useful way of measuring stress, it is desirable that they are used in conjunction with other methodologies that are more reflective of naturally occurring stressors.

1.8.2 Daily Hassles

Daily hassles have been defined as 'events, thoughts or situations which, when they occur produce negative feelings such as annoyance, irritation, worry or frustration, and/or make you aware that your goals and plans will be more difficult or impossible to achieve' (O'Connor et al., 2008, p. S20). Daily hassles or 'stressors' can be internal or external in nature, and any event has the potential to be a stressor (Cassidy, 1999). The occurrence of daily hassles, alongside fluctuations in the frequency of daily hassles experienced have been shown to be of great importance for the stress-health relationship (Kanner et al., 1981; Delongis et al., 1982; Affleck et al., 1994; Dancey et al., 1998; Filfield et al., 2004; Sher, 2004; O'Connor et al., 2008). It is possible that daily external demands may lead to illness, with the illness itself then becoming a source of

stress (Cassidy, 1999). It has been argued by Kanner et al. (1981) that it is “day-to-day events that ultimately have proximal significance for health outcomes and whose accumulative impact . . . should be assessed” (p. 3), and that the measurement of life event stress provides no understanding about what really occurs in everyday life.

Research conducted by O’Connor et al. (2009) explored the effects of conscientiousness and daily hassles on a collection of health behaviours. Results revealed that conscientiousness was negatively associated with the number of daily hassles reported, whilst number of daily hassles reported were significantly associated with a selection of health behaviours, for example, daily hassles were found to be positively associated with unhealthy eating behaviours, caffeine intake, and smoking (in smokers).

Other recent literature has also highlighted the importance of change within day-to-day hassles (Segerstrom & O’Connor, 2012), which further highlights the important understanding that stress is a process that is open to change over time (Kanner et al., 1981). The above research has significant implications for future research examining the conscientiousness-health-longevity relationship, as it highlights the important effects that stress, when conceptualised in terms of daily hassles, may have upon health.

1.8.3 Daily Diaries

The use of diary methods within psychology is well established (e.g., Jones et al., 2007). However, the use of daily diaries within research investigating the effects of personality and stress on health are less common. Currently, it is argued that there is an over reliance on cross-sectional methodologies within the current body of literature, and that such methodologies do not allow for causality to be conferred (Segerstrom & O’Connor, 2012). Segerstrom and O’Connor (2012) have argued that ‘Such [cross-sectional] approaches have ignored the burgeoning body of evidence showing that fluctuations in within-person stressful daily hassles are important in understanding stress-outcome processes and that major stressors can have a cascading effect on daily undesirable events’ (p. 134). Correspondingly, Bogg and Roberts (2004) recommended that future research should employ methods that allow for more definitive tests of the relationship between conscientiousness and health behaviours, following the finding

that less than 10% of the studies included in their meta-analysis tracked changes over time.

The use of daily diary methods, sometimes referred to as experience sampling methods, allow for momentary patterns and changes in behaviour that may ultimately influence important outcomes to be recorded and assessed. These 'in situ' assessments are a means to overcome the 'snap-shot' (e.g., perceived stress over a given period of time) measures of health, which often only measure behaviour at a single point in time.

Although these desirable diary methods are not widely utilised, they are becoming more popular (e.g., O'Connor et al., 2008; O'Connor et al., 2009; Verkuil et al., 2012; Gartland et al., 2013; O'Connor et al., 2015. By utilising such methods, the recording of daily hassles and health behaviours over a consecutive period of time has been possible. Importantly, daily diaries have a number of valuable qualities. For example, daily diaries do not constrain participants to reporting a limited number of events (O'Connor et al., 2008), and are not subject to close ended questions, allowing participants to generate detailed and descriptive data. Additionally, daily diaries are able to be delivered electronically, and thus reduce burden on participants in terms of time and ease of completion. Further support for the use of such techniques comes from Affleck et al. (1999) who suggest that employment of daily diaries allow researchers to ''(a) to capture as closely as possible the ''real-time'' occurrences or moments of change (in study variables); (b) to reduce recall bias; (c) to mitigate some forms of confounding by using participants as their own controls and (d) to establish temporal precedence to strengthen causal inferences' (p. 747).

Ferguson (2005) has highlighted that there are in fact three distinct diary protocols that can be used. Firstly, there is the 'interval-contingent' method. Within this design, participants complete the daily diary entry at a specified time, as determined by the researcher. Secondly, there is the 'event-contingent' method. Within this method participants are permitted to complete the diary entry immediately after the event has occurred. Lastly, there is the 'signal-contingent' method. Within this protocol, participants are required to complete the diary entry when a signal is sent, e.g., an alarm, that could be modified or sent by the researcher at varying time points. For those reasons, the use of this method is flexible in regards to the requirements of the research topic, and provides the researcher with high levels of control.

Recently, O'Connor et al. (2015) utilised daily diaries to examine the effectiveness of a stress management intervention on subsequent eating behaviour.

Importantly, the use of daily diaries allowed the researchers to employ the sophisticated technique of multi-level modelling. Within this analytical method, day-to-day within person (Level 1) differences (e.g., daily hassles, eating behaviour) are able to be examined alongside between person (Level 2) factors (e.g., personality). Within this technique, the association between level 1 and level 2 variables are able to be tested, and the moderating effects of other variables on this relationship are also able to be examined. According to Raudenbush et al. (2004), multi-level modelling is an appropriate method to employ for regression analyses with multi-level data as well as for multi-level repeated measures data, such as the data generated by daily diaries.

With regards to the aforementioned research conducted by O'Connor et al. (2015), Hagger (2015) has commented that the use of daily diary methods as means of examining eating behaviour is a step-change towards measuring eating behaviour more accurately, as well as comprehensively; furthermore, Hagger (2015) highlighted the use of multi-level analysis as a means of assisting behaviour change, rather than mere behaviour prediction, which is important in light of the current body of literature supporting the need for behaviour change.

Therefore, it can be seen that the use of daily diary designs and the analytical tool of multi-level modelling are highly desirable and highly favoured techniques. As the uses of such methodologies seem highly appropriate for the study of personality, stress and health behaviours, they will therefore be utilised within this current research.

1.9 Summary

It is likely that the relationship between conscientiousness and longevity is multifaceted and results from a wide range of processes that occur throughout the life span. It is unlikely to be the case that one determinant in early life would have a simple and unalterable effect on health in later life (Friedman et al., 2014), which highlights the significance and importance of processes and interventions that occur across the years. It has been suggested by Friedman (2008) that 'multiple causal linkages between personality and disease may be simultaneously operating across long periods of time' (p. 668); therefore it is likely that the mediators and moderators of the conscientiousness-health-longevity relationship will interact with one another. For example, individuals scoring low in conscientiousness may be more vulnerable to experiencing the stressful life event of divorce, which may then produce chronic stress, which may in turn lead to engagement in unhealthy behaviours, which may then impact physical health.

Furthermore, the individual effects of behaviours may be insignificant alone, but an accumulation of these insignificant behaviours over a long period of time may have a substantial effect on one's health status.

In summary, much work has been conducted in order to define conscientiousness and its lower order structure. Although some disagreements remain, the key aspects of conscientiousness have been identified. Alongside this, measures employed to assess conscientiousness are increasing in reliability and have been demonstrated to capture a range of conscientiousness's lower order facets. Moreover, the relationship between conscientiousness, health behaviours and longevity is well established, yet alternative mechanisms explaining this relationship still require much attention in order to be fully understood.

Stress has been hypothesised to be associated with the conscientiousness-health-longevity relationship in a number of ways, such as via the mechanisms of exposure and reactivity, as outlined in the framework proposed by Bolger and Zuckerman (1995). Although there is evidence available to support this association, more research is required to further elucidate the relationship. More recently, stress has been assessed in terms of daily hassles. Research within this field has yielded promising results, and has signified the importance of studying stress over time. New and improved methodologies to study health behaviours are becoming increasingly popular, and are endorsed by a number of researchers. With these advances, sophisticated analytical techniques are also able to be utilised, which are helping to resolve the difficulties associated with correlational designs, particular in regard to inferring causality. The main aim of this thesis was to further understand the conscientiousness-health behaviour relationship and to further understand the alternate mechanisms through which conscientiousness conveys its beneficial effects on health. Each of the chapters within this thesis addressed this aim via a range of methods.

Chapter 2 examines the mechanism of behavioural intention as a mediator of the conscientiousness-fruit and vegetable consumption relationship, a health behaviour that has been previously identified as being particularly under researched in relation to conscientiousness. Chapter 3 focusses upon confirming the lower order structure of conscientiousness, and further establishing the relationship between the lower order facets of conscientiousness and specific health behaviours, when they are assessed independently and when assessed as an overall index. In particular, this chapter assesses whether conscientiousness is associated with health behaviour guideline adherence, a

matter which has been identified as being particularly unclear in the current body of literature. Chapter 4 examines the under researched mechanism of stress within the conscientiousness-health relationship, specifically in relation to stress reactivity in accordance with the framework outlined by Bolger and Zuckerman (1995). Last, chapter 5 also addresses the mechanism of stress, but this time in terms of stress exposure. Here the relationship between unhealthy between-meal snacking and daily hassles are assessed, and the effectiveness of an implementation intention based intervention to reduce unhealthy between-meal snacking is examined. Specifically, this is assessed in relation to individuals low and high in conscientiousness. As a result, this research addresses the main aim of this thesis 'to further understand the conscientiousness-health behaviour relationship and to further understand the alternate mechanisms through which conscientiousness conveys its beneficial effects on health' via a range of approaches and methodologies.

1.10 Thesis Structure

The thesis consists of six chapters that are each outlined below. A visual representation of the thesis can also be seen in Figure 1.2.

Chapter 1 - Introduction and overview

Chapter 2 – Cross-sectional survey:

This chapter presents survey data from a large scale study of 2136 participants collected within the USA. Here the relationship between conscientiousness, as well as its lower order facets, with fruit and vegetable consumption are investigated. Behavioural intention was also explored as a mediator of this relationship in order to assess its role within the conscientiousness-health behaviour relationship.

Chapter 3 – Cross-sectional survey:

This chapter described data from an online survey from a sample of 879 participants. The lower order structure of conscientiousness was assessed, and the relationships between the following variables are explored. Conscientiousness and its lower order facets, engagement with the health behaviours smoking, alcohol intake, fruit and vegetable consumption and physical activity, and a health behaviour guideline adherence index examining how many UK government health behaviour guidelines were

adhered to. Here, the structure of conscientiousness and the conscientiousness-health behaviour relationship were examined in further detail to build upon previous findings.

Chapter 4 – Laboratory study:

This chapter presents data collected from a laboratory study with 101 participants which examined differences in physiological reactiveness and recovery to acute stress in participants with low and high levels of conscientiousness. The chapter also explores whether individuals low and high in conscientiousness perceive stress differently and the effects of stress on emotional state in these groups. This allowed stress reactivity to be examined as a mechanism through which conscientiousness may influence health.

Chapter 5 – Intervention and daily diary study:

This chapter provides data collected from a 14 day daily diary study examining daily hassles and daily snacking. The chapter discusses the effects of an implementation intention based intervention known as the Eating Management Support tool in those low and high in conscientiousness, in terms of the above daily diary outcomes. The effect of conscientiousness on the daily hassles-unhealthy snacking relationship is also investigated. This allowed stress exposure to be examined as a mechanism through which conscientiousness may convey its effects on health.

Chapter 6 – General discussion

This chapter concludes the findings of this current research and integrates them with the existing literature. Here, the novelty of this research is discussed, alongside the limitations of the thesis and the implications of this work for future research.

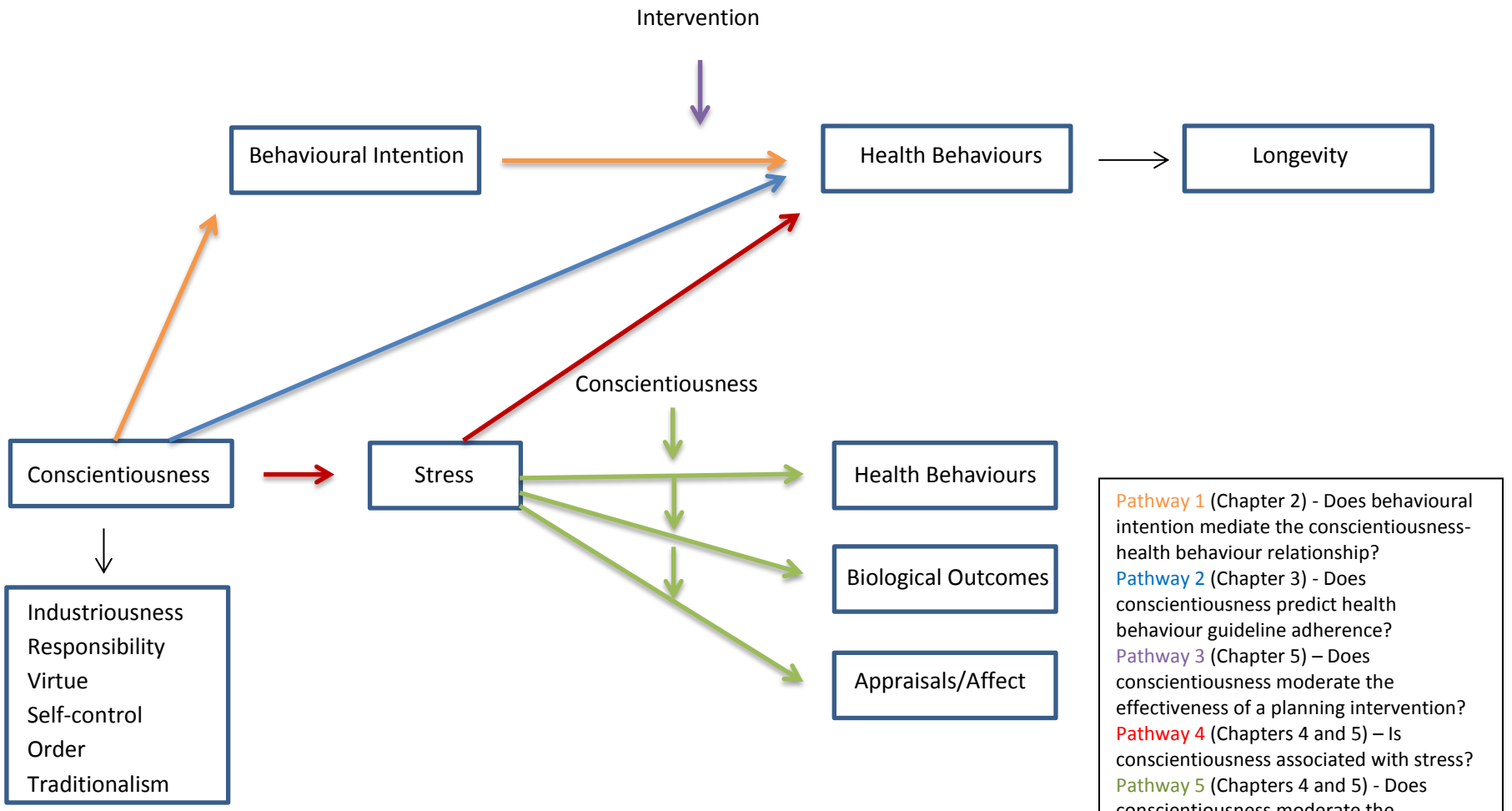

Figure 1.2. A Schematic Representation of the thesis

Chapter 2

2 STUDY 1: CONSCIENTIOUSNESS AND FRUIT AND VEGETABLE CONSUMPTION: EXPLORING BEHAVIOURAL INTENTION AS A MEDIATOR

2.1 Introduction

Within this chapter the associations between conscientiousness and health behaviours are tested, with a specific focus upon the health behaviour fruit and vegetable consumption. Alongside this, the Theory of Planned Behaviour (Ajzen 1988, 1991) variable of behavioural intention is proposed as a mediator of the conscientiousness–fruit and vegetable consumption relationship. Furthermore, conscientiousness is described and assessed at facet level throughout the chapter. The main aims of this chapter were firstly to assess the associations between conscientiousness, behavioural intention to consume fruit and vegetables and self-reported fruit and vegetable consumption, and secondly to explore behavioural intention as a mediator of the conscientiousness-fruit and vegetable consumption relationship.

Conscientiousness is a personality trait characterised by the propensity to follow socially prescribed norms and rules regarding impulse control and to be goal directed, planful, and able to delay gratification (John & Srivastava, 1999). Over recent years clear associations have emerged between conscientiousness and longevity; with higher levels of conscientiousness predicting greater longevity (Friedman et al., 1993; Kern & Friedman., 2008; Fry & Debats, 2009), across a range of developmental stages (Taylor et al., 2009; Weiss & Costa, 2005). One prominent longitudinal study demonstrated that individuals who were rated as more conscientious by parents and teachers at the age of eight were found to have lived longer when followed up over seven decades later (Friedman et al, 1993). More recently, systematic research has supported this association, with a recent meta-analysis demonstrating a correlation of r = .11 (between conscientiousness and longevity (Kern & Friedman, 2008).

Further research has indicated that individuals who score higher on measures of conscientiousness often engage in more beneficial health behaviours (Friedman et al., 1993; Bogg & Roberts, 2004; Hampson et al., 2006; O'Connor et al., 2009), and have better physical health (Hampson et al., 2007; Moffitt et al., 2011). Supporting research from Friedman and colleagues (1995) revealed that the positive effects of conscientiousness on health were partly mediated by its effects on decreasing detrimental health behaviours such as smoking and alcohol consumption, whilst meta-analysis of 194 studies demonstrated that conscientiousness was positively correlated with physical activity; and negatively correlated with excessive alcohol use, unhealthy eating, tobacco use, drug use, risky driving, risky sex and suicide (Bogg & Roberts, 2004). These findings offer a possible explanation for increased longevity, such that conscientiousness is associated with a healthier lifestyle which has a direct impact upon physical health.

More recent research, including the current study, has focused upon the mechanisms through which conscientiousness may convey such beneficial health effects. Research from Conner and Abraham (2001) found that conscientiousness was significantly associated with behavioural intentions to form health protective goals, such that higher scores of conscientiousness were positively correlated with scores regarding 'Looking after my health in the next 2 weeks'. Furthermore, a second study from Conner and Abraham (2001) indicated that conscientiousness was positively correlated with intentions to exercise. Therefore, it seems that individuals who score high on conscientiousness may be more likely to form stronger intentions with regards to their health behaviours, which in turn translate into healthier patterns of behaviour.

Behavioural intention is a central construct in models of health behaviour such as the Theory of Reasoned Action (Fishbein & Ajzen., 1975, 1980) and the Theory of Planned Behaviour (Ajzen, 1988, 1991). The Theory of Planned Behaviour (TPB) is arguably one of the most popular and widely used models of understanding and predicting health behaviour (Conner & Norman., 2005; Ajzen, 2011). This theory suggests that behaviour is directed by behavioural intention - which in turn, is directed by individual's attitudes (a person's overall evaluation of the given behaviour), subjective norms (the influence of significant others) and perceived behavioural control (an individual's perceived ease or difficulty of performing the particular behaviour). Within this theory, personality, age, gender and socio-demographic status are thought to be mediated by the social cognition aspects of the model (attitudes, subjective

norms, perceived behavioural control and intention). It follows then that the beneficial effects of conscientiousness on behaviour will be mediated by behavioural intention as the most proximal predictor of behaviour.

Relatively little research has combined the TPB with conscientiousness to predict health behaviours; with existing research having mostly examined physical activity (Courneya et al., 1999; Conner & Abraham, 2001). However, research from de Bruijn et al. (2009) demonstrated that individuals high in conscientiousness had a significantly higher intake of fruit than those low in conscientiousness, and that this relationship was mediated via the Theory of Planned Behaviour variables (TPB; Ajzen, 1988, 1991), as well as action planning (de Bruijn., 2013). With this important finding in mind, further development is required to examine whether the TPB mediates the relationship not only between conscientiousness and fruit consumption but for vegetable consumption as well in a large representative sample. Furthermore, most research exploring the relationship between conscientiousness and eating behaviour has examined unhealthy eating behaviour (Bogg & Roberts, 2004), and has often employed measures such as BMI as indicators of eating, with a couple of notable exceptions (de Bruijn et al., 2009; de Bruijn 2013).

Given the importance of fruit and vegetable consumption for health, with the understanding that adequate consumption of fruit and vegetables reduces the risk for cardiovascular disease and cancer, and that approximately 1.7 million (2.8%) deaths (per annum) worldwide are attributable to low fruit and vegetable intake; it is critical that we focus upon fruit and vegetable consumption alongside other health behaviours (World Health Organisation, 2003). Despite the widely understood health benefits of eating fruit and vegetables, consumption still remains inadequate in western countries (World Health Organisation, 2003). Therefore, it is particularly important that we fully understand this relationship, to enable the design of successful interventions to encourage increased intake. In addition, emerging research is beginning to highlight the importance of tailoring interventions in relation to individual characteristics such as personality (e.g., O'Connor et al., 2009).

Although some prior research has examined the relationship between conscientiousness, TPB and fruit and vegetable consumption (de Bruijn et al., 2009; de Bruijn, 2013), few studies (if any) have adopted a facet level approach. Over the past twenty years, the operationalization of conscientiousness has been explored, providing the foundations to generate a clear, measurable, universal classification of the lower

order facets of the trait (Perugini & Gallucci, 1997; Saucier & Ostendorf 1999; Roberts et al., 2004; Roberts et al., 2005; De Raad & Peabody, 2005; De Young et al., 2007; MacCann et al., 2009; Jackson et al., 2010). Roberts et al. (2005) identified the structure of conscientiousness based upon seven widely used personality questionnaires. Factor analysis of thirty-six scales related to conscientiousness revealed a structure of six facets: industriousness, responsibility, order, self-control, traditionalism and virtue. Although a number of studies have since obtained different results to those determined by Roberts et al. (2005) (e.g., MacCann et al., 2009), more recent research from Roberts et al., (2012) has demonstrated how most facets identified in subsequent research load onto one of the facets identified in their 2005 study. Moreover, research is emerging indicating that lower order facets of conscientiousness have differential effects on health behaviours, such that some facets are best conceptualised as having proactive qualities (e.g., industriousness) and others inhibitive (e.g., self-control) aspects (e.g., O'Connor et al., 2009; Gartland et al., 2013). Therefore, in the current study, we explored the relationship between these six lower order facets and fruit and vegetable consumption.

Therefore, it is clear to see that the way in which conscientiousness is conceptualised has transformed over recent years. It seems that conscientiousness can no longer be thought of as a unified construct, but rather a compilation of facets each contributing their own piece to the conscientiousness puzzle. Although conscientiousness has been consistently associated with longevity and health status, research has progressed from questioning *what* conscientiousness does, to *why* and *how* conscientiousness conveys such effects. Factors that moderate or mediate the relationship between conscientiousness and health are not yet well understood (Carver & Connor-Smith, 2010; Hampson, 2012; Luo & Roberts 2015), with Hong and Paunonen (2009) arguing that "there is still an enormous lack of understanding regarding which lower-level facets nested under each of the Big Five factors are most responsible for the observed personality-health behaviour relations" (p. 678). Therefore, the current study aimed to explore the role of the lower order facets in the context of consumption of fruit *and* vegetables in a large representative sample.

In sum, we predicted that: (1) conscientiousness and its facets (in particular, industriousness & traditionalism) will be positively correlated with behavioural intentions to consume fruit and vegetables and self-reported fruit and vegetable

behaviour, and (2) the effects of conscientiousness and its facets on self-reported fruit and vegetable behaviour will be mediated by behavioural intention.

2.2 Method

2.2.1 Participants

A sample of 2136 participants were recruited across the United States for a large cross-sectional study (1092 women, 1044 men) with a mean age of 50.96 years (range = 20 - 101 years old). Participants were largely of a Caucasian ethnicity (N = 1691, 79.2% of the sample) the remaining 21% were Black, non-Hispanic (9%), Hispanic (7%), and other ethnicities (5%). The majority of participants were employed (53.5%), and 28.2% were retired. Participants were recruited via the Knowledge Networks, Inc. survey administration service, which holds a portfolio of participants who are contacted when a suitable survey becomes available to them. The system employs a probability-based sampling service to deliver a representative sample. All participants provided informed consent prior to participation and were de-briefed post participation. Participants were informed that the purpose of the study was to investigate age differences in personality traits and how personality and health-behaviours may change with age. The only inclusion criteria for this study was that participants were of an adult age. Data collection was conducted by Dr Patrick L Hill and Professor Brent W Roberts, University of Illinois at Urbana-Champaign.

2.2.2 Measures

2.2.2.1 Conscientiousness

Conscientiousness was assessed using the 60 item Chernyshenko Conscientiousness Scale (CCS; Green et al., 2015). The scale consists of 60 items assessing each facet of conscientiousness. The facets measured were industriousness, order, traditionalism, self-control, responsibility and virtue. *Industriousness* can be described as the propensity to work hard, to strive for achievement and to be persistent. Items included ‘I try to be the best at everything I do’. *Order* concerns the ability to be organised, efficient and plan. Items included ‘Organization is a key component of most things I do’. *Traditionalism* refers to the degree to which individuals follow socially prescribed norms and rules, alongside levels of adherence to authority. Items included ‘I have the highest respect for authorities and assist them whenever I can’. *Self-Control*

concerns the ability of individuals to delay gratification and inhibit impulsive tendencies. Items included 'I rarely jump into something without first thinking about it'. *Responsibility* refers to how reliable and dependable a person is considered. This facet also refers to the degree to which an individual contributes time and money to their community. Items included 'I go moral, honest and grounded. Items included 'If I cashier forgot to charge me for an item I would tell him/her'. Each facet has demonstrated differential predictive validity (Hill & Roberts, 2011). Items were scored on a four point Likert scale with responses of disagree strongly, disagree somewhat, agree somewhat and agree strongly provided as options. A high score indicated a high level of conscientiousness. The overall scores of the six facets were averaged to create an overall score of conscientiousness (Cronbach's $\alpha = .82$).

2.2.2.2 Behavioural Intention

Intentions to engage with the target behaviour were measured using a 7 point Likert scale. Intention to consume fruit or vegetables was assessed through the item 'I intend to eat five fruits and/or vegetables a day', 'please indicate how much you agree or disagree with the statement'. Options ranged from strongly agree (7) to strongly disagree (1), following the procedures outlined by Conner and Norman (2005).

2.2.2.3 Self-Reported Fruit and Vegetable Consumption

Eating behaviour was assessed through questions examining fruit and vegetables consumed during the past seven days, drawn from the Behavioural Risk Factor Surveillance System (BRFSS; National Center for Chronic Disease Prevention and Health Promotion, 2000). Five items asked participants to report responses on a 7 point scale with responses varying from 'I did not have any during the past 7 days' through to '4 or more times per day'. Items included 'How many times did you drink 100% fruit juices such as orange juice, apple juice or grape juice?', 'How many times did you eat green salad?', 'How many times did you eat carrots?', 'How many times did you eat vegetables other than green salad or carrots?' and 'How many times did you eat fruit? (Do not count fruit juice)'. Participant responses to these five items were averaged to create an overall score of fruit and vegetable eating behaviour, with a high score indicating a greater number of fruits and vegetables consumed (Cronbach's $\alpha = .78$).

2.2.3 Procedure

Participants were asked to complete a demographic questionnaire, the Chernyshenko Conscientiousness Scale (Hill & Roberts, 2011), a questionnaire examining eating behaviour and a number of other questionnaires that are not discussed here. Questionnaires were delivered to participants in an online format. The battery of questionnaires took approximately one hour to complete. The questionnaire items were not presented randomly, with the personality items administered first in the survey. Participants were compensated $30 (USD) upon completion of the questionnaires. This study received ethical approval from the University of Illinois' Institutional Review Board.

2.2.4 Statistical Analysis

Descriptive statistics and Pearson's product-moment correlation coefficients were performed to enable examination of the relationships between variables. Hierarchical multiple regressions were employed to examine the effects of conscientiousness and its facets on fruit and vegetable consumption and any mediation effects (Preacher & Hayes, 2008). Study variables were mean centred before being entered into the regression analyses and checked for internal reliability. All analysis was performed in SPSS Version 20.0 by the author.

2.3 Results

2.3.1 Descriptive statistics

Descriptive statistics for each measure alongside correlation coefficients between each study variable are presented in Table 2.1.

2.3.2 Preliminary correlation analysis

Overall, the Pearson product-moment correlation coefficients showed that each facet of conscientiousness (industriousness, order, traditionalism, self-control, responsibility and virtue), alongside total conscientiousness was positively correlated with behavioural intention. Of the conscientiousness measures, total conscientiousness was most highly correlated with behavioural intention, r = .21, CI [.17, .25], closely followed by industriousness, r = .19, CI [.15, .23] and responsibility, r = .19, CI [.15, .23]; suggesting that individuals scoring highly on these three particular measures of

conscientiousness had stronger intentions to consume 5 fruits and/or vegetables a day. Furthermore, each facet of conscientiousness and total conscientiousness were positively correlated with self-reported behaviour. Again, the largest correlation was seen between total conscientiousness and self-reported behaviour, *r* = .11, CI [.07, .16], followed by virtue, r = .11, CI [.06, .15]. These correlations suggest that individuals scoring highly on these particular measures of conscientiousness are more likely to report consuming a greater number of portions of fruit and/or vegetables a day, and are similar in magnitude to those found in the Bogg and Roberts (2004) meta-analysis. A moderate positive correlation between behavioural intention and self-reported behaviour was observed, *r* = .46, CI [.42, .49] suggesting that participants intentions to consume 5 portions of fruit and/or vegetables a day were closely related to a greater consumption of fruit and/or vegetables.

2.3.3 Testing mediation effects

The preliminary correlation analysis demonstrated that there were statistically significant relationships between conscientiousness (independent variable), behavioural intention (mediator) and self-reported behaviour (dependent variable). Therefore the analysis was continued to test for mediation as initial observations inferred that conditions 1 and 2 of mediation were met for behavioural intention (see below).

Baron and Kenny (1986) defined a number of criteria necessary for testing mediation. Accordingly, mediation is confirmed when the following conditions hold: (1) The independent variable (i.e. conscientiousness) affects the mediator (i.e. behavioural intention); (2) The independent variable affects the dependent variable (i.e. self-reported behaviour); (3) The mediator affects the dependent variable when the independent variable is controlled for; (4) Full mediation is confirmed if the effect of the independent variable on the dependent variable is no longer significant when the mediator is controlled for. If only conditions 1, 2 and 3 are met then only partial mediation is confirmed.

Multiple regression analyses were conducted to assess each component of the proposed mediation model using the Indirect SPSS Macro (Preacher & Hayes, 2008). Within the analysis, age, gender and education were entered as control variables as previous research has confirmed the effects of these variables on levels of conscientiousness (Noftle & Robins, 2007; Gartland et al., 2012; Vollrath et al., 2012).

Table 2.1. Means, standard deviations and Pearson product-moment correlation coefficients for conscientiousness, behavioural intention and self-reported behaviour (*N* = 2031 – 2132)

		1	2	3	4	5	6	7	8	9
1.	Conscientiousness	__								
2.	Industriousness	.79 [.77, .80]	__							
3.	Order	.64 [.62, .67]	.44 [.40, .48]	__						
4.	Traditionalism	.70 [.68, .72]	.39 [.35, .43]	.31 [.26, .35]	__					
5.	Self-Control	.71 [.69, .74]	.47 [.43, .50]	.32 [.28, .37]	.40 [.36, .44]	__				
6.	Responsibility	.80 [.78, .81]	.69 [.66, .72]	.37 [.34, .41]	.42 [.38, .46]	.55 [.52, .59]	__			
7.	Virtue	.73 [.71, .75]	.45 [.41, .49]	.21 [.17, .26]	.57 [.53, .59]	.45 [.41, .49]	.54 [.50, .57]	__		
8.	Behavioural Intention	.21 [.17, .25]	.19 [.15, .23]	.15 [.10, .19]	.11 [.06, .15]	.10 [.06, .15]	.19 [.15, .23]	.17 [.13, .21]	__	
9.	Self-reported Behaviour	.11 [.07, .16]	.09 [.04, .13]	.10 [.06, .14]	.05 [.01, .10]	.05 [.01, .09]	.08 [.03, .13]	.11 [.06, .15]	.46 [.42, .49]	__
	Mean	3.04	3.18	2.91	2.88	3.03	3.19	3.07	4.31	2.59
	SD	.35	.49	.58	.45	.43	.41	.51	1.81	.94
	Cronbach's α	.82	.86	.82	.76	.78	.75	.80	__	__

Note: Each of the correlation coefficients were significant at the 0.05 level (2-tailed).

The effects of total conscientiousness and its facets were entered into separate analyses. Please note, the results were substantively the same for men and women, therefore, the findings for the whole sample are presented throughout.

2.3.4 Behavioural Intention as a mediator

2.3.4.1 Total Conscientiousness

Stage one analysis demonstrated that total conscientiousness significantly predicted behavioural intention (B = .90, *t* (2022) = 8.11, *p* < .01). Stage two analysis demonstrated that total conscientiousness significantly predicted self-reported behaviour (B = .20, *t* (2022) = 3.45, *p* < .01). Stage three results indicated that the mediator, behavioural intention, significantly predicted self-reported behaviour (B = .24, *t* (2022) = 22.56, *p* <.01). As conditions 1-3 for mediation were met, mediation analysis was tested using the bootstrap method with bias-corrected confidence estimates (MacKinnon et al., 2004; Preacher & Hayes, 2004). In this present study, the 95% confidence interval of the indirect effects was obtained with 5000 bootstrap samples (Preacher & Hayes, 2008). Results of the mediation analysis confirmed the mediating role of behavioural intention in the relationship between total conscientiousness and self-reported behaviour (B= .21, CI = .16 to .28). In addition, results indicated that the direct effect of total conscientiousness on self-reported behaviour became non-significant (B = -.01, *t* (2022) = -.21, *p* = *ns*) when controlling for behavioural intention, thus suggesting full mediation.

2.3.4.2 Industriousness

Stage one analysis demonstrated that industriousness significantly predicted behavioural intention (B = .57, *t* (2028) = 7.32, *p* < .01). Stage two analysis demonstrated that industriousness significantly predicted self-reported behaviour (B = .11, *t* (2028) = 2.77, *p* < .01). Stage three results indicated that the mediator, behavioural intention, significantly predicted self-reported behaviour (B = .24, *t* (2028) = 22.69, *p* <.01). Results of the mediation analysis confirmed the mediating role of behavioural intention in the relationship between industriousness and self-reported behaviour, (B = .14), CI [.10, .18]. In addition, results indicated that the direct effect of industriousness on self-reported behaviour became non-significant (B = -.02, *t* (2028) = -.59, *p* = *ns*) when controlling for behavioural intention, thus suggesting full mediation.

2.3.4.3 Order

Stage one analysis demonstrated that order significantly predicted behavioural intention (B = .38, *t* (2027) = 5.83, *p* < .01). Stage two analysis demonstrated that order significantly predicted self-reported behaviour (B = .13, *t* (2027) = 3.73, *p* < .01). Stage three results indicated that the mediator, behavioural intention, significantly predicted self-reported behaviour (B = .23, *t* (2027) = 22.57, *p* <.01). Results of the mediation analysis confirmed the mediating role of behavioural intention in the relationship between order and self-reported behaviour, (B = .09), CI [.06, .12]. In addition, results indicated that the direct effect of order on self-reported behaviour became non-significant (B = -.04, *t* (2027) = 1.24, *p* = *ns*) when controlling for behavioural intention, thus suggesting full mediation.

2.3.4.4 Responsibility

Stage one analysis demonstrated that responsibility significantly predicted behavioural intention (B = .66, *t* (2027) = 7.05, *p* < .01). Stage two analysis demonstrated that responsibility significantly predicted self-reported behaviour (B = .12, *t* (2027) = 2.34, *p* < .01). Stage three results indicated that the mediator, behavioural intention, significantly predicted self-reported behaviour (B = .24, *t* (2027) = 22.76, *p* <.01). Results of the mediation analysis confirmed the mediating role of behavioural intention in the relationship between responsibility and self-reported behaviour, (B = .16), CI [.11, .21]. In addition, results indicated that the direct effect of responsibility on self-reported behaviour became non-significant (B = -.04, *t* (2027) = -0.93, *p* = *ns*) when controlling for behavioural intention, thus suggesting full mediation.

2.3.4.5 Virtue

Stage one analysis demonstrated that virtue significantly predicted behavioural intention (B = .53, *t* (2028) = 6.91, *p* < .01). Stage two analysis demonstrated that virtue significantly predicted self-reported behaviour (B = .13, *t* (2028) = 3.13, *p* < .01). Stage three results indicated that the mediator, behavioural intention, significantly predicted self-reported behaviour (B = .24, *t* (2028) = 22.63, *p* < .01). Results of the mediation analysis confirmed the mediating role of behavioural intention in the relationship between virtue and self-reported behaviour, (B = .13), CI [.09, .16]. In addition, results

indicated that the direct effect of virtue on self-reported behaviour became non-significant (B = .00, *t* (2028) = .03, *p* = *ns*) when controlling for behavioural intention, thus suggesting full mediation.

2.3.4.6 Self-control and Traditionalism

Regression analyses demonstrated that scores of self-control and traditionalism were not significantly associated with self-reported behaviour, therefore not meeting condition 2, and thus no further mediation analysis was deemed necessary.

Table 2.2. Mediation analyses testing each of the lower order facets of conscientiousness (*N* = 2023 – 2029)

	β (step 1)	β (step 2)	β (step 3)	β (step 4)
Total conscientiousness	.90*	.20*	.24*	-.01
Industriousness	.57*	.11*	.24*	-.02
Order	.37*	.13*	.24*	.04
Responsibility	.66*	.12*	.24*	-.04
Virtue	.53*	.13*	.24*	.00
Self-Control	.30*	.04	.24*	-.03
Traditionalism	.32*	.06	.24*	-.01

Note: β = the unstandardized beta coefficient, * = p <.01

(Step 1) The IV predicts the Mediator

(Step 2) The IV predicts the DV

(Step 3) The Mediator predicts the DV

(Step 4) The IV predicts the DV whilst controlling for the Mediator

2.4 Discussion

In sum, the results of this large scale study have provided evidence in support of our hypotheses, that conscientiousness and its facets are positively correlated with both behavioural intention to consume fruits and vegetables and self-reported fruit and vegetable behaviour. Moreover, the findings confirm that the effects of conscientiousness on self-reported behaviour are fully mediated by behavioural intention; when conscientiousness was conceptualised in terms of a unified construct, as well as in terms of the facets of responsibility, virtue, industriousness, and order. With reference to the effects of total conscientiousness, responsibility, order, virtue and industriousness; analyses demonstrated that a substantial amount of the variance in self-reported behaviour was explained by behavioural intention (range = 20.1% - 20.4%), suggesting that behavioural intention is particularly important for understanding the conscientiousness-health behaviour relationship. These results are notable because they support the notion that conscientiousness exerts some of its influence via self-regulatory processes that could be targeted in future behaviour change interventions.

A secondary aim of this study was to elucidate which facets of conscientiousness were most strongly associated with fruit and vegetable consumption. A meta-analysis conducted by Bogg and Roberts (2004) demonstrated that the facets industriousness and traditionalism were the most important facets in relation to eating behaviour; which is somewhat consistent with the current findings. One possible reason for the variation seen with the facet of traditionalism could be due to the differing ways in which healthy eating was assessed, with the current study focusing on fruit and vegetable consumption and Bogg and Robert's (2004) review focusing upon different types of eating behaviour (e.g., unhealthy snacking; 21% of studies) and measures of weight as an indicator of eating behaviour (e.g., BMI; 79% of studies). Likewise, research from O'Connor et al (2009) found that of the facets examined only the order facet was associated with daily fruit intake and that lower levels of self-efficacy were associated with decreased vegetable consumption on stressful days. Although studies in this area of research are largely lacking, one reason why there is such variability in findings may be due to the way in which conscientiousness has been operationalized. For example, O'Connor et al (2009) employed the IPIP (Goldberg, 1999) as a measurement of conscientiousness, therefore making trends difficult to discern due to a lack of comparability. Thus far, it is difficult to identify any emerging patterns between particular health behaviours and specific facets. Moreover, the differential effects of the

facets support the need to continue to investigate conscientiousness at facet and global levels.

Discussing facets in terms of being proactive or inhibitive lends an interesting way to think about the facets of conscientiousness. This has been previously articulated by Costa et al. (1991) who conceptualised conscientiousness as having both proactive (e.g. achievement striving) and inhibitive (e.g. cautiousness) aspects. It may therefore be possible to classify the facets identified in the Chernyshenko Conscientiousness Scales (CCS; Green et al., 2015) as either being largely proactive or inhibitory. Furthermore, it may well prove to be the case that the more proactive facets are of particular importance for behaviours such as fruit and vegetable consumption that one needs to actively engage with, whereas on the other hand, facets potentially classified as more inhibitory may be particularly important for health behaviours such as smoking that one needs to be submissive towards. An interesting avenue for future research would be to build upon this finding by examining which facets are of greatest importance for which health behaviours, as well as whether there are any patterns to be found for approach and avoidance health behaviours.

In comparison to previous research, the magnitudes of the correlations observed were of similar strength to those observed in prior research from Conner and Abraham (2001), and of greater magnitude to those of Bruijn et al. (2009, 2013). In terms of the amount of variance explained, behavioural intention was found to explain a relatively large portion of the variance self-reported behaviour.

An argument could be made that the effect sizes were small. However, the correlations and partial correlations found in the current study are entirely consistent with most prior research linking personality traits to health behaviours (Bogg & Roberts, 2004) and to the average effect sizes found in social and personality psychology (Fraley & Marks, 2007). That is to say, the effect sizes for most social science research result in small effect sizes. Nonetheless, the correlations have indicated an interesting relationship between behavioural intention and the facets of conscientiousness, which could be particularly important in directing future research and for informing future interventions tailored to vulnerable populations.

We acknowledge that there are a number of limitations that require further comment. First, the cross sectional nature of the research limits the conclusions that can be drawn regarding the causal direction between conscientiousness and behaviour. However, past longitudinal designs have revealed the causal direction of this

relationship (e.g., Friedman et al, 1993), which is reassuring. Longitudinal designs are therefore desirable for future research for replication purposes. Second, the measure of behavioural intention employed ought to be improved. Behavioural intention was not questioned in relation to a specific time scale and was assessed using a single item measure. Delving further into the details of one's intentions may have improved the predictive utility of the measure. Nevertheless, it is likely that with improved measures, particularly that of behavioural intention, it would be possible to see the true strength of this relationship. Therefore, future research ought to utilise a longitudinal design incorporating improved measures of behaviour.

In sum, this novel research, which employed a large and diverse sample, has been successful in its aims, and has enhanced the current body of literature. Subsequently, a mechanism through which conscientiousness may exert its protective effects has been identified, and further knowledge of which facets of conscientiousness may be more closely related to fruit and vegetable consumption has been gained. This current study has provided further support for the hypotheses that conscientiousness delivers its beneficial effects through the formation of stronger intentions. This knowledge can be utilised to inform interventions to target those vulnerable individuals with low levels of conscientiousness.

Chapter 3

3 STUDY 2: CAN CONSCIENTIOUSNESS PREDICT ENGAGEMENT WITH U.K. HEALTH BEHAVIOUR GUIDELINES?

3.1 Introduction

This chapter discusses the relations between conscientiousness, longevity, and health behaviours, alongside the lower order structure of conscientiousness. In addition, the health behaviours smoking, physical activity, alcohol intake and fruit and vegetable consumption are discussed in relation to the current U.K. guidelines. The main aims of this chapter are to explore the lower order structure of conscientiousness, to examine whether conscientiousness and its facets can predict health behaviour guideline adherence when the health behaviours are examined individually and when combined; and lastly, to explore the extent to which the effects of conscientiousness on health behaviour guideline adherence differed in individuals with varying levels of conscientiousness.

3.1.1 Conscientiousness and Health

It is well established that conscientiousness is associated with positive outcomes (Ozer & Benet-Martınez 2006; Hampson, 2012), such as job performance and marriage success (Barrick & Mount, 1991; Dudley et al., 2006; Roberts et al., 2007) however; a most remarkable effect of conscientiousness is on health and longevity (Friedman et al., 1995; Bogg & Roberts, 2004; Hagger-Johnson & Whiteman, 2007; Bogg & Roberts; 2012).

Most studies linking conscientiousness to health behaviours have focussed upon individual health behaviours. From the studies included in the Bogg and Roberts (2004) meta-analysis, the majority of the studies examined only one health behaviour, and thus there is less understood about the relationship between conscientiousness and a healthy lifestyle more generally.

3.1.2 The structure of conscientiousness

The recent publication from Green et al. (2015), which aimed to further validate the six factor structure of conscientiousness previously identified (Roberts et al., 2005), examined the lower order structure of conscientiousness in both US and UK samples. Results suggested that the facets of industriousness, order, self-control, traditionalism and virtue all factored well, whilst the facet of responsibility required further investigation. This is not to say that conscientiousness may be best represented by a five factor structure, but rather that the items comprising the responsibility facet perhaps ought to be revised. As a result of this development, we deemed it necessary to explore the lower order structure of conscientiousness, in accordance with the Chernyshenko Conscientiousness Scales (Chernyshenko, 2002; Hill & Roberts, 2012), taking a closer look at the facet of responsibility within this chapter.

Research from Paunonen (1998) has supported the development of research studying personality at facet level based on investigations demonstrating better predictions of behaviour from the narrow facets when compared to broad factors, even when the number of facet predictors was limited. Further support for this argument comes from the finding that the facets do not correlate perfectly with each other, or their broad personality factor (Goldberg, 1999). It may be that individuals scoring high or low on particular facets of conscientiousness are more likely to practice particular health behaviours. This not only raises the importance of studying conscientiousness at facet level, as there may well be associations between particular facets and specific behaviours, but on the cumulative effect of engaging in a range of unhealthy behaviours, meaning that even if the effects of individual behaviours are small, the combined effect of a number of behaviours together may be particularly detrimental to one's health.

3.1.3 The relationship between the facets of conscientiousness and health behaviours

Previous research has indicated specific associations between facets and health behaviours. The meta-analysis from Bogg and Roberts (2004) suggested that physical activity was most strongly associated with the facets of traditionalism and industriousness, alcohol intake was most strongly associated with self-control and traditionalism and smoking behaviour was most strongly associated with industriousness and self-control. Similarly, research from O'Connor et al. (2009)

demonstrated that fruit intake was most strongly associated with the order facet. Additionally, Bogg and Roberts (2004) demonstrated that of the health behaviours examined, the strongest relationships observed were between conscientiousness and drug use (r = -.28), alcohol consumption (r = -.25), risky driving (r = -.25), and violence (r = -.25) followed by tobacco use (r =-.14), unhealthy eating (r = -.13), risky sex (r =-.13) and suicide (r = -.12). The smallest relationship observed was between conscientiousness and physical activity (r = .05). Based upon these findings, we predicted a similar pattern would emerge in the current study, both in terms of the strength of the relationships between total conscientiousness and each health behaviour examined; as well as between the particular facets and health behaviours.

Whilst considering issues of measurement, another factor that ought to be considered is the method by which health behaviours have been measured, as this has varied widely between studies (Schall et al., 1992; Sharkansky & Finn, 1998; Nagoshi, 1999; Vollrath et al., 1999; Stewart et al., 2001). As a result of such variations in measurement it is unclear whether individuals high in conscientiousness are meeting the national guidelines for health behaviours. Although previous research has indicated that individuals scoring high in conscientiousness engage in more beneficial health behaviours, for example, they consume more portions of fruit (O'Connor et al., 2009; de Bruijn., 2011), it is not clear whether they do meet the U.K. guidelines, or whether they simply consume more than their low conscientiousness counterparts. Meeting U.K. health behaviour guidelines is of great importance as failure to meet such guidelines may have deleterious effects on health and wellbeing. A recent government report ('Living well for longer' 2014, Department of Health) highlighted the 'top five killers' as cancer, heart disease, stroke, respiratory disease and liver disease. Here it was suggested that of the 150, 000 deaths attributable to these health problems, two-thirds of them were avoidable. Smoking, drinking too much alcohol, a poor diet and a lack of physical activity were all named as contributors to early death. Failure to consume 5 portions of fruit and vegetables per day increases the risk of serious health problems such as heart disease, stroke, cancer, obesity and type-two diabetes (www.nhs.uk). Smoking is the leading cause of cancer and death from cancer. It can also cause heart disease, stroke, aortic aneurysm, chronic obstructive pulmonary disease, asthma, hip fractures and cataracts. Smokers are also at a higher risk of developing pneumonia and other airway infections (www.cancer.gov). Furthermore, excessive alcohol intake above the guidelines increases the risk of liver disease, high blood pressure, heart disease,

cancers, and reduced fertility and physical activity guideline adherence can reduce the risk of heart disease, stroke, diabetes and cancer by up to 50%, as well as reducing the risk of stress, depression, dementia and Alzheimer's disease (www.nhs.uk). Therefore, it is fundamental that we fully understand whether those scoring low in conscientiousness are failing to meet such guidelines in order for appropriate interventions to be developed.

Therefore, the first aim of this study was to explore the structure of conscientiousness in terms of its lower order facets. The second aim of this study was to examine whether conscientiousness and its facets can predict alcohol intake, smoking, physical activity and fruit and vegetable consumption guideline adherence when examined as individual health behaviours as well as when they were combined to create an overall health index. The final aim of this study was to explore the extent to which the effects of conscientiousness on health behaviour guideline adherence differed in individuals scoring high or low in conscientiousness (based on scores in the top 25% and bottom 25% of the sample).

3.2 Method

3.2.1 Participants

A sample of 879 participants were recruited from within the United Kingdom, primarily the Leeds area (750 women, 129 men) with a mean age of 27 years (range = 18 - 79 years old). Participants were largely of a Caucasian ethnicity (89.3% of the sample); the remaining 10.7 % were Chinese (1.5%), Indian or Pakistani (1.6%), African (.8%) or other ethnicities including mixed ethnicities (6.8%). The majority of the participants were students (65.3%), while 33.9 % were employed or retired, and 0.8% did not disclose this information. 43.9% of the sample had completed their A-Levels, 36% had reached undergraduate degree level and 17% had reached post-graduate degree level, indicating a highly educated sample. Participants were recruited via opportunity sampling through university based participant pool schemes, advertisement posters and social media websites. Participants were informed that the purpose of the study was to investigate the relationship between personality and health behaviours amongst the general population. The inclusion criteria for this study were that participants were 18 years or older, spoke fluent English and were generally in good health.

3.2.2 Measures

3.2.2.1 Conscientiousness

Conscientiousness was assessed using the 60 item Chernyshenko Conscientiousness Scales (CCS; Chernyshenko, 2002; Hill & Roberts, 2011). The scale consists of 60 items assessing each facet of conscientiousness. The facets measured were industriousness, order, traditionalism, self-control, responsibility and virtue. *Industriousness* can be described as the propensity to work hard, to strive for achievement and to be persistent. Items included 'I try to be the best at everything I do'. *Order* concerns the ability to be organised, efficient and plan. Items included 'Organization is a key component of most things I do'. *Traditionalism* refers to the degree to which individuals follow socially prescribed norms and rules, alongside levels of adherence to authority. Items included 'I have the highest respect for authorities and assist them whenever I can'. *Self-Control* concerns the ability of individuals to delay gratification and inhibit impulsive tendencies. Items included 'I rarely jump into something without first thinking about it'. *Responsibility* refers to how reliable and dependable a person is considered. This facet also refers to the degree to which an individual contributes time and money to their community. Items included 'I go out of my way to keep my promises'. Virtue describes the propensity to be moral, honest and grounded. Items included 'If I cashier forgot to charge me for an item I would tell him/her'. Items were scored on a four point Likert scale with responses of disagree strongly, disagree somewhat, agree somewhat and agree strongly provided as options. The overall scores of the six facets were averaged to create an overall score of conscientiousness (Cronbach's $\alpha = 0.91$), with scores ranging on a scale of 0 - 4. A high score indicated a high level of conscientiousness.

3.2.2.2 Health Behaviours

3.2.2.2.1 Fruit and Vegetable Consumption

Fruit and vegetable consumption was assessed using the items 'on average, how many portions of fruit do you eat a day?' and 'on average, how many portions of vegetables do you eat a day?' The responses to these items were summed to create a total number of portions of fruit and vegetables consumed on an average day. These responses were also then coded as 'yes' or 'no' in terms of whether they met the

current U.K. guidelines, which state that five portions of fruit and vegetables should be consumed per day (www.nhs.uk/livewell/5aday). Participants were provided with detailed information (sourced from the Department of Health website - https://www.gov.uk/government/organisations/department-of-health) regarding portion sizes for both fruit and vegetables, e.g., an adult portion size is approximately equivalent to 80 grams in weight. Dried fruit portion sizes are approximately equivalent to 30 grams in weight. Participants were asked to include fresh, canned, frozen, or dried fruit and vegetables, and were provided with examples of portion sizes, e.g., portions of fruit are one medium apple, one medium banana, two kiwi fruit, two plums, half a large grapefruit. Examples of portions of vegetables are three heaped tablespoons of carrots, three heaped tablespoons of beans, three heaped tablespoons of frozen mixed vegetables, two spears of broccoli, eight sprouts, one medium onion, half a pepper or a 150ml glass of 100% juice (fruit or vegetable juice). Participants were informed to count juice as only one portion a day no matter how much they drank, to count beans and other pulses (such as kidney beans) as only one portion a day no matter how much they ate and not to count potatoes.

3.2.2.2.2 Alcohol Intake

Alcohol intake was assessed via the item 'during a typical 7-day period (a week), how many of the following drinks do you drink?' Participants were then asked to indicate 'how many pints of beer/lager/cider?', 'How many measures of spirits? (1 = single shot, 2 = double shot)' and 'How many glasses of wine? (Standard glass = 175ml)'. Information sourced from www.nhs.uk was used to determine how many units of alcohol are contained in each type of drink. Each reported drink was multiplied by the number of units of alcohol for that type of drink. The total for the three types of drink were then summed to create an average number of units of alcohol consumed on an average week. U.K. guidelines determine that a female should not consume more than 2-3 units of alcohol per day, and a male should not consume more than 3-4 units of alcohol per day, equivalent to 14-21 units of alcohol for a female and 21-28 units of alcohol for a male (www.nhs.uk/livewell/alcohol). The median recommended number of alcohol units was used to determine adherence to guidelines, e.g. 17.5 for females and 24.5 for males. Participant's responses were coded as 'yes' (1) or 'no' (0) in terms of whether they met the current U.K. guidelines.

3.2.2.2.3 Smoking

Smoking behaviour was assessed using the item 'Do you smoke?' Responses were entered as 'yes' (1) or 'no' (0). Participants were regarded as adhering to U.K. smoking guidelines if they responded 'no' (www.gosmokefree.nhs.uk).

3.2.2.2.4 Physical Activity

Physical activity was assessed in terms of strenuous activity, moderate activity and mild activity. Items were adapted from the International Physical Activity Questionnaire (www.ipaq.ki.se). The following item was initially delivered 'During a typical 7-day period (a week), how many times on average do you do the following kinds of exercise?' followed by 'Strenuous exercise (heart beats rapidly) e.g., running, jogging, hockey, football, squash, basketball, judo, roller skating, vigorous swimming, vigorous long distance bicycling', 'Moderate exercise (not exhausting) e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming' and 'Mild exercise (minimal effort) e.g., yoga, archery, fishing from river bank, bowling, golf, easy walking'. Participants were then required to respond to 'Number of times per week' and 'How much time do you usually spend doing these activities on one of those days (hours/minutes)?' to each item. The total number of minutes spent undertaking each type of activity per week was then calculated. Physical activity guidelines (sourced from www.gov.uk) stated that per week, 150 minutes of moderate exercise, or 75 minutes of strenuous (intense) exercise should be undertaken. Participants were then coded as 'yes' (1) or 'no' (0) in terms of whether they met the U.K. guideline for moderate and strenuous exercise. Participants who met the guideline for moderate and/or strenuous activity were then coded as 'yes' or 'no' in terms of whether they meet the current U.K. guidelines.

3.2.2.2.5 Health Behaviour Guideline Adherence Index

A health behaviour index was created to measure the cumulative effect of adherence to each of the four behaviour guidelines. Participants were given a score of 0 to 4, indicating the number of guidelines that they adhered to.

3.2.3 Procedure

Participants registered with the University of Leeds participant pool scheme were invited to participate in the study via email. Participants were asked to complete a

demographic questionnaire, the Chernyshenko Conscientiousness Scales (Hill & Roberts, 2011; Green et al., 2015), and a questionnaire examining health behaviours. Questionnaires were delivered to participants in an online format and all entries were anonymous. The battery of questionnaires took approximately fifteen minutes to complete. Participants were entered into a £50 prize draw for completing the questionnaires. This study received ethical approval from the Institute of Psychological Sciences, University of Leeds Ethics Committee.

3.2.4 Statistical Analysis

In order to examine the structure of conscientiousness, the internal reliability of each of the facets was initially assessed by examining Cronbach's alpha values. Further to this, data were factor analysed with a principal components factor analysis. This was performed with an oblique rotation (direct oblimin), the preferred method when factors are hypothesised to be related (Field, 2009, p. 664). Next, descriptive statistics and point biserial Pearson product moment correlation coefficients were computed in order to examine the relationships between the study variables. Hierarchical regression analyses were then performed to test the individual effects of conscientiousness and its facets on the health behaviour guideline adherence index. This was followed by hierarchical regression analyses examining the simultaneous effects of the conscientiousness facets on the health behaviour guideline adherence index. All analyses were performed in SPSS version 21.0.

3.3 Results

3.3.1 Exploration of the lower order structure of conscientiousness

3.3.1.1 Scale Reliability

The internal reliability of each of the facets was initially assessed by examining Cronbach's alpha values. All values were above the critical value of .7 (Cortina, 1993) and can be found in Table 3.1.

Next, a principal components factor analysis was conducted on the sixty items with oblique rotation (direct oblimin). A fixed number of 6 factors were set to be extracted based upon the previously stated lower order structure of conscientiousness (Roberts et al., 2005; Roberts et al., 2014; Green et al., 2015). Factor loadings below the absolute value of 0.4 were supressed. Initial analysis revealed that all six factors had

eigenvalues over Kaiser's value of 1, and these six factors cumulatively explained 39.97% of the variance. Table 1 presents the factor loadings after oblique rotation. The six facets of conscientiousness are each represented by one factor. However, not all items met the absolute value of .4.

The six factor structure for the data revealed that five factors had between six to ten strongly loaded items (<.4). The items representing the facets of industriousness, order, virtue, self-control and traditionalism loaded together on single factors as anticipated, largely reflecting the facet scales. Of the anticipated items, ten items loaded onto factor one and two (industriousness and order), nine items loaded onto factor three and four (self-control and virtue) and six items loaded onto factor five (traditionalism).

However, the sixth factor which items represented the facet of responsibility did not factor well with only three items loading above the value of .4. Two of the responsibility items 'I carry out my obligations to the best of my ability'(RESP1) and 'I often feel responsible for making sure that all group project assignments are completed' (RESP2) loaded onto the factor representing industriousness over the value of .4 and one of the traditionalism items 'Even if I knew how to get around the rules without breaking them, I would not do it' (TRAD4) loaded on to virtue above the value of .4 suggesting that these items are measuring a combination of each facet.

The three items that had loaded on to Responsibility were examined in terms of their internal reliability ('Sometimes it is too much of a bother to do exactly what is promised' (RESP4), 'If I am running late to an appointment, I may decide not to go at all' (RESP6) and 'When I make mistakes I often blame others' (RESP9)). Cronbach's alpha revealed a value of 0.44 suggesting that these three items did not demonstrate good internal reliability.

Overall, five of the six factors - industriousness, order, self-control, virtue and traditionalism scaled and factored well into five distinct factors. However, the sixth factor responsibility did not hold up as a coherent construct once subjected to factor analysis. However, for the purpose of subsequent analyses, the original six factor structure has been retained.

Table 3.1. Summary of exploratory factor analysis results for the lower order structure of conscientiousness (*N* = 879)

Item Code	Item	Factor 1 IND	Factor 2 ORD	Factor 3 SC	Factor 4 TRAD	Factor 5 VIRT	Factor 6 RESP
ORD1	Being neat is not exactly my strength	.02	-.72	.08	-.01	-.06	.07
ORD2	Organisation is a key component of most things I do	.25	-.57	.13	.044	.01	.04
ORD3	I need a neat environment in order to work well	-.07	-.71	-.10	-.02	.09	-.08
ORD4	I become annoyed when things around me are disorganised	.05	-.66	-.04	-.03	.03	-.22
ORD5	For me, being organised is unimportant	.11	-.54	.08	-.03	.06	.01
ORD6	Half of the time I do not put things in their proper place	-.00	-.77	.00	-.02	.02	.16
ORD7	Most of the time my room is in complete disarray	-.07	-.76	.02	-.04	.03	.21
ORD8	Every item in my room and on my desk has its own designated place	.01	-.63	.03	.06	-.01	-.09
ORD9	I frequently forget to put things back in their proper place	.03	-.70	.06	-.07	-.03	.19
ORD10	I hate when people are sloppy	.18	-.46	-.05	.06	-.01	-.22
VIRT1	If I could get away with it, I would not pay taxes	-.08	.03	.16	-.05	.54	-.14
VIRT2	I would lie without hesitation if it serves my purpose	-.10	-.05	.01	-.08	.73	.18
VIRT3	I would be insincere and dishonest if a situation required me to do so	-.06	-.12	-.02	-.04	.68	.13

VIRT4	If I find money laying around, I'll keep it to myself	-.05	.01	-.08	.06	.42	.08
VIRT5	If a cashier forgot to charge me for an item I would tell him/her	.00	.01	-.05	.04	.43	.04
VIRT6	I would rather get a bad grade than copy someone else's homework and turn it in as my own	.20	.08	.16	-.16	.28	.03
VIRT7	It bothers me when people cheat on their taxes	.11	.04	.09	.06	.44	-.17
VIRT8	If I accidentally scratched a parked car, I would try to find the owner to pay for the repairs	.04	-.01	.05	.08	.45	-.15
VIRT9	I firmly believe that under no circumstances it is okay to lie	-.07	-.16	-.12	.17	.58	-.06
VIRT10	The people who know me best would say that I am honest	.19	-.03	.03	-.00	.48	.12
TRAD1	I have the highest respect for authorities and assist them whenever I can	.05	.03	.10	.69	.19	.01
TRAD2	People respect authority more than they should	.06	.11	.09	.57	-.07	.17
TRAD3	Even if I knew how to get around the rules without breaking them, I would not do it	.05	-.01	.15	.32	.41	-.12
TRAD4	I believe that people should be allowed to take drugs, as long as it doesn't affect others	.05	-.03	.03	.44	.07	.17
TRAD5	I support long-established rules and traditions	.03	.02	-.06	.64	.05	.01
TRAD6	People who resist authority should be severely punished	.07	-.02	-.07	.73	-.08	-.13
TRAD7	When I was in school, I used to break the rules quite	-.07	-.09	.39	. 31	-.01	.03

	regularly						
TRAD8	In my opinion, all laws should be strictly enforced	-.01	-.05	.00	.63	.07	-.07
TRAD9	In my opinion, censorship slows down the progress	-.07	-.04	-.13	.34	-.04	.31
TRAD10	When working with others I am the one who makes sure that rules are observed	.18	-.00	.25	.39	.16	-.20
SC1	I often rush into action without thinking about potential consequences	-.01	-.04	.77	-.00	-.06	.04
SC2	I rarely jump into something without first thinking about it	.02	-.05	.73	-.02	-.05	-.12
SC3	I am known to make quick, hot-headed decisions	.05	-.02	.55	-.06	-.09	.17
SC4	I do not take unnecessary risks	-.10	-.05	.62	.05	.14	-.07
SC5	I am easily talked into doing silly things	.13	-.03	.59	-.01	-.01	.18
SC6	My friends say I am unpredictable	-.07	-.05	.61	.05	-.02	.25
SC7	I get into trouble because I act on impulses rather than on thoughts	-.01	-.04	.76	-.01	-.03	.22
SC8	I am careful with what I say to others	.08	.09	.46	.02	.03	-.08
SC9	I dislike being around impulsive people	-.11	-.08	.32	.08	.04	-.21
SC10	Even under time pressure, I would rather take my time to think about my answer than to say the first things that comes to mind	.08	.01	.49	-.06	.08	-.19
RESP1	I carry out my obligations to the best of my ability	.53	.02	.18	.03	.13	.06

RESP2	I often feel responsible for making sure that all group project assignments are completed	.47	.00	.13	.15	.05	-.11
RESP3	I go out of my way to keep my promises	.37	.07	-.05	.03	.18	.27
RESP4	Sometimes it is too much of a bother to do exactly what is promised	.16	.12	.07	.09	.11	.49
RESP5	I would gladly spend some of my leisure time trying to improve my community	.21	.11	-.04	-.08	.24	.09
RESP6	If I am running late to an appointment, I may decide not to go at all	.10	-.12	.11	.03	.07	.48
RESP7	I am usually not the most responsible group member, but I will not shirk on my duties either	.21	-.22	.15	.07	-.03	.17
RESP8	If I am running late, I try to call ahead to notify those who are waiting for me	.17	-.10	.15	.01	.13	.32
RESP9	When I make mistakes I often blame others	.09	-.06	.03	-.15	.33	.41
RESP10	I have a reputation for being late for almost every meeting or event	.08	-.19	.17	.13	.00	.35
IND1	I have high standards and work towards them	.75	-.06	.07	.05	-.06	-.09
IND2	I go above and beyond what is required	.80	-.03	-.03	.03	-.01	-.07
IND3	I do not work as hard as the majority of people around me	.55	-.16	.01	.02	.02	.18
IND4	I invest little effort into my work	.58	-.10	.01	-.13	.07	.17

IND5	I demand the highest quality in everything I do	.69	-.22	.05	.05	-.04	-.15
IND6	I try to be the best at anything I do	.71	-.08	-.07	.13	-.04	-.17
IND7	I make every effort to do more than what is expected of me	.73	-.06	-.04	.08	.06	-.11
IND8	I do what is required, but rarely anything more	.66	.06	-.03	-.03	.05	.14
IND9	Setting goals and achieving them is not very important to me	.41	.02	-.01	-.03	-.03	.09
IND10	Getting average grades is enough for me	.44	-.04	.02	.01	-.15	.06
	Eigenvalues	10.16	3.66	3.19	2.84	2.46	1.68
	% of variance	16.94	6.10	5.32	4.73	4.09	2.80
	A	.87	.71	.75	.82	.70	.86

Note: Factor loadings over.40 are in bold.

3.3.2 The predictive effects of conscientiousness on health behaviour guidelines

3.3.2.1 Descriptive statistics

Descriptive statistics for conscientiousness and each of its facets can be found in Table 3.2. Overall, individuals scored highest on the facet of responsibility (3.13), followed by industriousness (2.91). The facet of traditionalism yielded the lowest mean score (2.60), whereas the facets of self-control, virtue and order all produced similar mean scores (ranging from 2.86-2.89).

Descriptive statistics for fruit and vegetable consumption, alcohol intake, smoking and physical activity can be found in Table 3.3. Of the health behaviours examined, the guideline for smoking, i.e., not smoking, was most highly adhered to (88.7% adherence), whereas the guideline for fruit and vegetable consumption was least adhered to (51.6% adherence). In the total sample, 4.9% met only one guideline, 24.7% met only two guidelines, 39.4% met only three guidelines and 29.9% met all four guidelines.

Table 3.2. Descriptive statistics for total conscientiousness and each of its facets

	Mean	SD
Total Conscientiousness	2.91	.31
Order	2.89	.59
Virtue	2.86	.43
Traditionalism	2.60	.43
Self-Control	2.87	.49
Responsibility	3.13	.50
Industriousness	2.91	.31

3.3.2.2 Preliminary correlation analysis

Table 3.4 displays the point-biserial correlation coefficients for each study variable. It was demonstrated that total conscientiousness was most strongly associated with guideline adherence for alcohol consumption r_{pb} = .18, p < .01, followed by smoking guideline adherence r_{pb} = .15, p < .01 and fruit and vegetable guideline adherence r_{pb} = .10, p < .01 but was not associated with physical activity guideline adherence r_{pb} =.01, p = *ns*. The facet of traditionalism was most highly correlated with smoking guideline adherence r_{pb} = .17, p < .01, whereas the facet of industriousness was most highly correlated with fruit and vegetable guideline adherence, r_{pb} = .16, p < .01, and the facet of self-control was most highly correlated to guideline adherence for alcohol intake, r_{pb} = .17, p < .01. Furthermore, total conscientiousness and each of its facets were positively correlated to the health behaviour guideline adherence index. Overall, the facet of industriousness was most highly correlated to the overall index, r_{pb} = .21, p < .01.

Table 3.3. Descriptive statistics for fruit and vegetable consumption, alcohol intake, smoking and physical activity

		Total Sample (*N* = 879)	
		Mean (SD)	Adherence %
Fruit and Veg (portions)		4.75(2.02)	51.6%
Alcohol	Males	14.92 (15.64)	79.8%
(units)	Females	10.08 (10.63)	81.5%
Smoking		—	88.7%
Physical Activity (minutes)	Moderate	171.66 (96.28)	70.4%
	Strenuous	100.29 (127.10)	70.4%
Guideline Adherence Index		2.92 (.92)	

Note: Adherence % relates to the number of participants meeting the U.K. guideline for the given behaviour.

3.3.2.3 Regression Analyses

Results that can be found in Table 3.5 suggest that after controlling for age, gender and education, total conscientiousness alongside the facets of order, virtue, traditionalism, self-control, responsibility and industriousness were able to predict the health behaviour guideline adherence index. Total conscientiousness was able to explain the most variance of the seven predictors, followed by industriousness and responsibility. Results presented in Table 3.6 demonstrated that when all of the facets were placed into the same regression model, only industriousness remained significant predictor of the health behaviour guideline adherence index. This suggests that industriousness is the preeminent facet at predicting the health behaviour guideline adherence index.

Table 3.4. Point–biserial correlation coefficients for each study variable (*N* = 856-879).

		1	2	3	4	5	6	7
1.	Conscientiousness	__						
2.	Order	.66*	__					
3.	Virtue	.56*	.13*	__				
4.	Traditionalism	.60*	.24*	.31*	__			
5.	Self-Control	.65*	.30*	.25*	.30*	__		
6.	Responsibility	.74*	.33*	.39*	.31*	.39*	__	
7.	Industriousness	.71*	.37*	.26*	.26*	.31*	.57*	__
8.	Smoking	.15*	.05	.09*	.17*	.09*	.10*	.11*
9.	Fruit and Veg	.10*	.06	.09*	.00	.00	.09*	.16*
10.	Alcohol	.18*	.11*	.06	.14*	.17*	.12*	.10*
11.	Physical Activity	.01	.03	.03	-.03	-.02	.02	.03
12.	Guideline Adherence Index	.19*	.11*	.11*	.10*	.14*	.18*	.19*

Note * = the correlation coefficients were significant at the .01 level (two-tailed)

Table 3.5. Hierarchical regression analyses testing the individual effects of conscientiousness and its facets on the health behaviour guideline adherence index (*N* =879)

		β (step 1)	β (step 2)	ΔR^2 for step	Total R^2
Total C					
Step 1	Age	-.03	-.07		
	Gender	.01	-.01		
	Education	.11*	.12*	.01*	
Step 2	Total C		.19*	.04*	.05
Order					
Step 1	Age	-.03	-.04		
	Gender	.01	.00		
	Education	.11*	.12*	.01*	
Step 2	Order		.11*	.01*	.02
Virtue					
Step 1	Age	-.03	-.06		
	Gender	.01	.00		
	Education	.11*	.12*	.01*	
Step 2	Virtue		.11*	.01*	.02
Traditionalism					
Step 1	Age	-.03	-.04		
	Gender	.01	-.01		
	Education	.11*	.12*	.01*	
Step 2	Traditionalism		.10*	.01*	.02
Self-Control					
Step 1	Age	-.03	-.05		
	Gender	.01	.01		
	Education	.11*	.12*	.01*	
Step 2	Self-Control		.10*	.01*	.02
Responsibility					
Step 1	Age	-.03	-.06		
	Gender	.01	.00	.01*	
	Education	.11*	.12*	.02*	
Step 2	Responsibility		.15*		.03
Industriousness					
Step 1	Age	-.03	-.05		
	Gender	.01	.00		
	Education	.11*	.11*	.01*	
Step 2	Industriousness		.17*	.03*	.04

Note: Total C = total conscientiousness

Table 3.6. Hierarchical regression analyses testing the simultaneous effects of conscientiousness on the health behaviour guideline adherence index (*N* =879)

		β (step 1)	β (step 2)	ΔR^2 for step	Total R^2
Step 1	Age	-.03	-.07		
	Gender	.01	.00		
	Education	.11*	.11*	.01	
Step 2	Order		.04		
	Virtue		.06		
	Traditionalism		.03		
	Self-Control		.02		
	Responsibility		.03		
	Industriousness		.11*	.04*	.05

Note: * = p < 0.01

3.3.2.4 Low Conscientiousness versus. High Conscientiousness

To test the final aim of the study, two sub-groups were created to represent low conscientiousness and high conscientiousness based on scores in the top and bottom 25% of the sample. Scores of 2.72 and below represented low conscientiousness and scores of 3.17 and above represented high conscientiousness. T-test results confirmed that these two groups were significantly different from each other, t (197) = -39.09, p < .01. Descriptive statistics for fruit and vegetable consumption, alcohol intake, smoking and physical activity by the sub-groups can be found in Table 3.7.

Descriptive statistics indicated that in comparison to those high in conscientiousness, individuals scoring low in conscientiousness consumed fewer portions of fruit and vegetables, consumed more alcohol (in both males and females), smoked more, and participated in physical activity less, apart from when physical activity was examined solely in terms of strenuous activity (when those low in conscientiousness exercised marginally more, 1.92 minutes more per week). The data indicated that with the exception of physical activity, the mean scores for each behaviour within the low conscientious group were below the total sample average, and the mean scores for each behaviour within the high conscientious group were above the sample average.

Table 3.7. Descriptive statistics for fruit and vegetable consumption, alcohol intake, smoking and physical activity in individuals scoring high and low in conscientiousness

		Low Conscientious (*N* = 251)		High Conscientious (*N* =173)	
		Mean (SD)	Adherence %	Mean (SD)	Adherence %
Fruit and Veg (portions)		4.61 (2.15)	48.6%	5.18 (2.00)	60.3%
Alcohol	Males	17.92 (16.25)	75.6%	11.04 (14.28)	86.4%
(units)	Females	12.66 (11.32)	74.8%	6.74 (7.20)	92.7%
Smoking		__	82.3%	__	94.8%
Physical Activity	Moderate	153.57	67.5%	177.91	68.4%
(minutes)		(164.49)		(193.35)	
	Strenuous	103.41(135.94)	67.5%	101.22(134.57)	68.4%
Guideline Adherence Index		2.73 (.99)		3.14 (.82)	

Note: Adherence % relates to the number of participants meeting the U.K. guideline for the given behaviour. There is no mean score for smoking as responses were 'yes' or 'no'.

Figure 3.1 presents the percentage of health behaviour guidelines adhered to in those scoring low and high in conscientiousness. In individuals scoring low in conscientiousness, 8.0% met only one guideline, 23.3% met only two guidelines, 43.8% met only three guidelines and 21.7% met all four guidelines. In those scoring high in conscientiousness, 1.1% met only one guideline, 24.1% met only two guidelines, 33.9% met only three guidelines and 40.8% met all four guidelines.

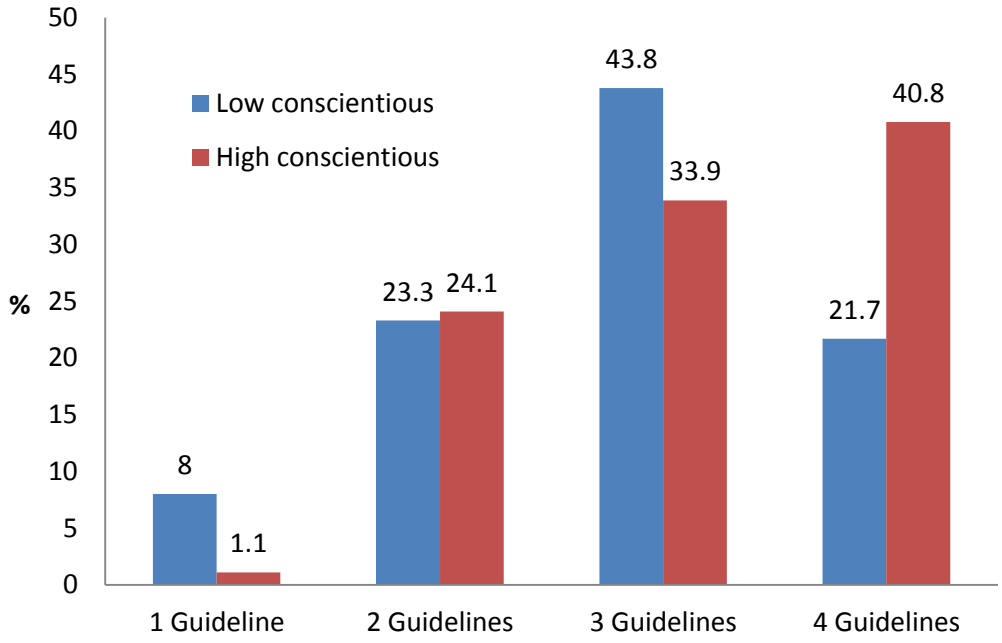

Figure 3.1. A visual representation of the percentage of health behaviour guidelines adhered to in those scoring low and high in conscientiousness

3.4 Discussion

This first aim of this study was to explore the structure of conscientiousness in terms of its lower order facets. Factor analysis revealed that the items employed to measure the facets of industriousness, order, virtue, traditionalism and self-control largely loaded onto five distinguishable factors. Each of these five factors demonstrated good internal reliability (as each factor produced a Cronbach's alpha above the critical value .70) suggesting that the items forming each facet measure were internally consistent. However, the sixth factor, responsibility, did not hold well within the factor analysis with only three items loading above the critical value (0.40). Although initially it demonstrated one of the highest levels of internal reliability, when the three items of responsibility that had factored over the critical value were assessed, internal reliability was poor (0.44). Therefore, it was concluded that the facet of responsibility should be approached with considerable caution when interpreting all other results. It was also demonstrated that two of the items intended to measure responsibility were in fact measuring the facet of industriousness to some extent. Upon closer examination, the three items that did factor above the critical value within the analysis suggest wide and varying traits that may be related to a number of other facets.

These findings are in line with those of Green et al. (2015) who demonstrated that until the responsibility facet is revised conscientiousness may be best approached in terms of a five factor structure. The conclusion that the facet of responsibility does

seem to be related to conscientiousness but in a broad sense rather than as a distinct facet seems appropriate for the current study as well. Therefore, the current items measuring the facet of responsibility require extensive revision if they are to be used to measure a distinct lower order scale of conscientiousness. Nevertheless, to allow comparison with other studies that use the CCS, the responsibility scale has been retained in the rest of the thesis.

The second aim of this study was to examine whether conscientiousness and its facets could predict alcohol intake, smoking, physical activity and fruit and vegetable consumption guideline adherence when examined simultaneously as well as independently. Results demonstrated that total conscientiousness and each of its facets were positively associated with adherence to the health behaviours smoking, fruit and vegetable consumption and alcohol intake but were not associated with physical activity. This result is not particularly surprising given the previously established modest relationship between conscientiousness and physical activity (Bogg & Roberts, 2004). Of the behaviours examined, total conscientiousness was most strongly associated with alcohol intake, followed by smoking and fruit and vegetable consumption. The strength of these relationships is in agreement with those of the Bogg and Roberts (2004) meta-analysis that demonstrated the same order and magnitude of findings. It therefore seems that conscientiousness may be more important for some health behaviours than others. Total conscientiousness and each of its facets were also positively associated with the health behaviour adherence guideline index, with the facet of industriousness emerging as the pre-eminent predictor of the index (r_{pb} = .21).

Furthermore, it was demonstrated that when examined independently, conscientiousness and each of its facets could predict the health behaviour guideline adherence index, after controlling for age, gender and education. Total conscientiousness was found to account for 4% of the variance in the health behaviour guideline adherence index. Although this was only a small percentage, it is still important as even small effects over the lifetime could have a significant impact upon health. After the effects of total conscientiousness, the facet of industriousness was visible as the strongest predictor of the health behaviour guideline adherence index. When each facet of conscientiousness was examined simultaneously as predictors of the health behaviour guideline adherence index, industriousness was the only significant predictor. This not only suggests that those scoring higher on levels of conscientiousness are more likely to meet health behaviour guidelines, which in turn may have a positive effect upon physical health, but that the facet of industriousness is particularly important for meeting important health behaviour guidelines. One possible explanation

for this may be the effortful, goal-achieving and hard-working nature of industriousness. In order to meet health behaviour targets, one would need to exert frequent effort, particularly for behaviours such as physical activity and fruit and vegetable consumption; alongside having high standards and setting goals. When examining the items that measure industriousness, it is clear to see that effort and high standards are reflected, e.g., 'I have high standards and work towards them' (IND1), 'I demand the highest quality in everything that I do' (IND5), 'setting goals and achieving them is not very important to me' (IND9, reversed item). Therefore, the amount of effort one exerts and the strength of their determination to achieve high quality results appear to be key determinants of health behaviour guideline adherence, and may be targets for tailored interventions.

In comparison to previous research, the magnitude of the correlations generated was in line with those produced in the previously discussed meta-analysis (Bogg & Roberts, 2004). However some of the findings here contradict those previously reported in the literature. Physical activity was found to have no significant association with conscientiousness or any of its facets, unlike Bogg and Roberts (2004) who found a small association. Smoking behaviour was found to be most highly associated with traditionalism, whereas the meta-analysis suggested the highest association was with industriousness and self-control. Fruit and vegetable consumption was found to be most strongly associated with industriousness, which is contrary to the results of O'Connor et al. (2009) who found order to be most strongly associated. However, consistent with Bogg and Roberts (2004) alcohol intake was found to be most highly associated with self-control. As a result of these mixed findings, the pattern between each facet and health behaviour is still difficult to discern. However, what is interesting is that fruit and vegetable consumption was most highly associated with industriousness – which may be perceived as comprising proactive qualities, whereas alcohol intake was associated with self-control, which may be perceived as comprising mostly inhibitive qualities. This idea has been previously articulated by Costa et al. (1991) who conceptualised conscientiousness as having both proactive (e.g. achievement striving) and inhibitive (e.g. cautiousness) aspects. It may therefore be possible to classify the facets identified in the Chernyshenko Conscientiousness Scales (Green et al., 2015) as either being largely proactive or inhibitory. Furthermore, it may well prove to be the case that the more proactive facets are of particular importance for behaviours such as fruit and vegetable consumption that one needs to actively engage with, whereas on the other hand, facets potentially classified as more inhibitory may be particularly important

for health behaviours such as smoking that one needs to abstain from. Further research is required in order to establish whether clear relationships do exist.

The final aim of this study was to explore the effects of conscientiousness on health behaviour guideline adherence in those scoring high and low in conscientiousness (i.e. the bottom 25% vs. top 25%). Results revealed that those scoring low in conscientiousness did not adhere to the five a day guideline to the same extent as those scoring high in conscientiousness (48.6% vs. 60.3%). Alongside this, they adhered to smoking guidelines less (82.3% vs. 94.8%) and adhered to alcohol intake guidelines less (males 75.6% vs. 86.4%, females 74.8% vs. 92.7%). Furthermore, what was particularly noteworthy was the finding that nearly twice as many high conscientious individuals met all four health behaviour guidelines in comparison to those low in conscientiousness (21.7% vs. 40.8%).

In relation to national averages, this sample smoked less – with the population average currently around 20% (www.ash.org.uk). For fruit and vegetable consumption, 51.6% of participants reported consuming five portions of fruit and vegetables per day, which in comparison to a large scale study of 65, 000 participants that found that only 25% of individuals meet the five a day guideline (Oyebode et al., 2014), was considerably high. Data collected in 2011 suggested that on average, males consumed 17 units of alcohol per week, and females consumed 9 units, which are both within the current guidelines (NHS, The Information Centre, 2011). Within our sample, those low in conscientiousness consumed more than the given average with only 74.8% - 75.6% adhering to the guideline, whereas in those scoring high in conscientiousness consumed less than the given average with 86.4% - 92.7% adhering to the guideline. A large scale study analysing physical activity data from over one million adults in England suggested that only around 20% of individuals were meeting the government guideline for physical activity (Hollingsworth et al., 2013). Within this current sample a considerably higher number of people reported meeting physical activity guidelines (67.5% - 68.4%). However, it is notable that the same study of one million adults found that people with a degree only had a 12% chance of being inactive. As the current sample was highly educated this provides one possible explanation for why such a contrasting result has been found. From these results, it seems that this sample adhered to guidelines above that of the national average.

However, there are a number of limitations to consider. One factor that ought to be considered is the high educational attainment and therefore possible high socioeconomic status of this sample. Previous research has suggested that educational level is a key determinant of socioeconomic status and therefore a determinant of

numerous life outcomes (Chapman et al. 2011a, Nabi et al. 2008) and so should always be considered as a moderating mechanism of conscientiousness. In addition, it emerged from the factor analysis that the six factor structure cumulatively explained only 39.97% of the variance in conscientiousness, which is not particularly high. Whether this is problematic is debatable, as all other analyses have demonstrated internal reliability and produced similar findings to those captured by a range of other conscientiousness measures (Bogg & Roberts, 2004).

In conclusion, the findings of this current study suggest that the items employed to measure the facets of industriousness, order, self-control, virtue and traditionalism are reliable and represent separate lower order facets of conscientiousness. However, the items employed to measure the facet of responsibility are not currently reliable and require extensive revision. It was also demonstrated that total conscientiousness and each of its facets were positively associated with adherence to the health behaviour guidelines for smoking, fruit and vegetable consumption and alcohol intake but were not associated with physical activity guideline adherence. Total conscientiousness and each of its facets were also positively associated with the health behaviour adherence guideline index. Therefore, it is now clear to see that those scoring high in conscientiousness are more likely to adhere to health behaviour guidelines in comparison to those low in conscientiousness, and are therefore not simply ‘more healthy’. Lastly, when comparing those low in conscientiousness to those high in conscientiousness, nearly twice as many high conscientious individuals met all four health behaviour guidelines in comparison to those low in conscientiousness.

Chapter 4

4 STUDY 3: PSYCHOLOGICAL AND PHYSIOLOGICAL STRESS REACTIVITY IN HIGH AND LOW CONSCIENTIOUSNESS INDIVIDUALS

4.1 Introduction

It is well established that conscientiousness exerts some of its protective effects on physical health and longevity via health behaviours (Friedman et al., 1993; Bogg & Roberts, 2004; Kern & Friedman., 2008; Molloy et al., 2014). However, more recent research, including this current study, has focused upon alternative mechanisms through which conscientiousness may convey its beneficial effects. One mechanism through which conscientiousness may affect health is through its influence on stress. Within this chapter, the relationship between conscientiousness and stress will be explored via the utilisation of a laboratory-based stress task. Furthermore, in line with the framework proposed by Bolger and Zuckerman (1995), psychological and physiological reactivity to the stressful task will be assessed in individuals with varying levels of conscientiousness. Psychological measurement will include the appraisal of the stressful task alongside state anxiety measures. Physiological measurement will include measures of blood pressure and heart rate activity. The main aim of this chapter is to identify any differences in reactivity to stress that are dependent upon level of conscientiousness.

4.1.1 Stress, conscientiousness and health

Stress can be defined in many ways; however it is common to conceptualise stress as a process whereby there is a stimulus, an appraisal of the stimulus, and a response (Cohen et al., 1995). Stimuli may be more commonly thought of as 'stressors' or 'hassles', and when these stimuli or 'stressors' are appraised as threatening or unmanageable, they elicit a physiological response that we commonly refer to as stress (Lazarus & Folkman, 1984).

Over recent decades it has become clear that the experience of stress is associated with a number of detrimental physical health outcomes; such as

hypertension, cardiovascular disease, cancers, HIV/AIDS and immune system suppression (Kulkarni et al., 1998; Reiche et al., 2004; Hamer & Malan, 2010); as well as perceived physical health (Luo & Roberts, 2015) and psychological health, such as depression (Hammen, 2005) and anxiety (Dyson & Renk, 2006). Stress is therefore associated with a wide range of health outcomes. It has been suggested that 'stress can alter health habits, increase the likelihood that one will seek medical attention, increase wear and tear on the physiological system, and interact with pre-existing vulnerabilities to produce illness, both psychological and physical' (Taylor, 2006, p. 211). Consequently, it seems that stress can impact our health both directly and indirectly. Interestingly, stress has not only been associated with these health outcomes, but has also been associated with the personality trait of conscientiousness, with a number of studies demonstrating a negative relationship between stress and conscientiousness (e.g., Gartland et al., 2013). In a longitudinal study examining the relations between conscientiousness, perceived stress and perceived physical health, perceived stress was found to partially mediate the association between conscientiousness and perceived physical health (Luo & Roberts, 2015). Furthermore, changes in conscientiousness were associated with changes in stress, with those whose levels of conscientiousness increased over time becoming less stressed over time, and conscientiousness change was associated with changes in perceived health. Therefore, it is possible that individuals low in conscientiousness may be more at risk of the deleterious effects of stress on health.

The idea that conscientiousness may influence health by interacting with stress was originally proposed by Friedman in 1993. Within his research, it was noted that health behaviours only partially mediated the relationship between conscientiousness and health, and thus stress was proposed as an alternative mediating variable. It has been established that conscientiousness can influence how individuals assess and respond to stressful situations. However, the precise role that conscientiousness plays remains unclear (e.g., Lee-Baggley et al., 2005). A number of different pathways have been proposed to explain the relationship between conscientiousness, stress and health. Conscientiousness has been suggested to be related to the ability to avoid stress, tolerate stress as well as manage stress (Besser & Shackelford, 2007). According to the framework proposed by Bolger and Zuckerman (1995), personality has the potential to influence both exposure to stressful events and reactivity to stressful events, and it is via both of these processes that the effects of personality on health outcomes can be

explained. However, although a number of pathways have been suggested, and a basic relationship has been established, the precise role that stress plays has not been widely investigated.

4.1.2 Psychological stress reactivity

In line with the framework proposed by Bolger and Zuckerman (1995), conscientiousness has been assessed in relation to reactivity to stress. One way in which reactivity to stress has been considered is via the ways in which individuals cope with stress dependent upon their level of conscientiousness. Research supporting this notion has indicated that those who score lower in conscientiousness were more likely to engage in unhealthy behaviours as a coping strategy in response to stress; with research demonstrating that daily stressors were associated with increased consumption of high fat and sugar snacks and with a reduction in main meals and vegetable consumption (O'Connor et al., 2009). Relatedly, other research has demonstrated that conscientiousness is associated with perceived coping ability in the face of stress exposure, with one study indicating that conscientiousness was positively correlated with perceived coping ability alongside perceived responsibility for and control over the situation (Penley & Tomaka, 2002). In addition, alternative research has suggested that conscientious individuals are able to cope better with stressful situations as they find them less demanding than their low conscientious counterparts (Connor-Smith & Flachsbart, 2007).

Research has also indicated that conscientiousness is related to the employment of specific coping strategies. Conscientiousness was shown to be positively associated with the use of approach style behaviours such as problem solving, cognitive restructuring, emotional social support, instrumental social support, and emotion regulation (Connor-Smith & Flachsbart; Roesch, et al., 2006; Vollrath & Torgersen, 2000; Bartley & Roesch., 2011); whilst negatively associated with avoidant style behaviours such as denial, negative emotion-focused, avoidant coping, and substance use as forms of coping (Connor-Smith & Flachsbart; Saklofske et al., 2007). Furthermore, research from O'Brien and DeLongis (1996) demonstrated that individuals who were high in conscientiousness employed less escape-avoidance and self-blaming strategies, when assessed over a range of situations.

It has been suggested that differences in coping style and coping strategies may be due to the way in which stressful situations are appraised (O'Brien & DeLongis, 1996).

The transactional model of stress (Lazarus & Folkman, 1984) suggests that there are two types of appraisal: primary and secondary. Primary appraisals concern evaluating the significance of the stressor, the risk involved and the demands and challenges that the situation presents. Secondary appraisals concern evaluating the level of control that the person holds over the situation as well as what resources they perceive themselves to have and whether they are able to influence the outcome of the situation. Therefore, high primary appraisal scores suggest heightened feelings of stress and threat, whereas high secondary appraisal scores reflect a greater ability to cope with the situation as well as influence the outcome of the situation.

The aforementioned research by Penley and Tomaka (2002) revealed that conscientiousness was negatively correlated with primary appraisals of a stressful task while positively correlated with secondary appraisals. This suggests that individuals low in conscientiousness may perceive stressful tasks as more stressful and demanding, whilst feeling less able to cope with the situation and less able to alter its outcome. Conversely, research conducted by Gartland et al. (2012) revealed that conscientiousness was positively correlated with primary appraisals of a daily hassles whilst negatively correlated with secondary appraisals. However, contrary to this argument, research from Shewchuk et al. (1999) suggested that individuals high in conscientiousness utilised more instrumental, proactive coping styles, regardless of how the stressor was appraised.

One possible explanation for such disparity may be the differing types of stress examined. Additional research is required to further understand the association between conscientiousness and appraisals, as the cumulative effect of such appraisals over time could have a negative impact upon health. It is also possible that individuals low in conscientiousness may not be able to successfully manage stressful situations to the same extent as their high conscientious counterparts and as such may be more likely to engage in unhealthy behaviours as a coping strategy, which contributes to health problems over the lifespan. In order to assess any conscientiousness related differences in the management of stressful situations, the cognitive appraisal of a stressful situation will be assessed within this current study.

4.1.3 State anxiety

Although appraisals are an important factor to consider when examining the stress-conscientiousness relationship, there are also other factors to consider. One such

factor is the role of state anxiety. State anxiety refers to the experience of negative emotions such as fear, nervousness or discomfort in response to a perceived stressor or threat at a particular moment in time. Experiences of these feelings have been shown to temporarily activate the autonomic nervous system (Spielberger & Sydeman, 1994). State anxiety has also been shown to be related to conscientiousness, with research from Booth et al. (2006) demonstrating that state anxiety was negatively associated with conscientiousness (r = -.26). Therefore, as state anxiety is related to both stress and conscientiousness, it is possible that it may play an important role in the conscientiousness–stress relationship, and will therefore be examined within this current study.

4.1.4 Physiological stress reactivity

Alongside psychological reactivity, it has been hypothesised that there may be individual variability in physiological reactions to stress; with evidence indicating that these variations in reactivity may be associated with conscientiousness. Although relatively little research has assessed this relationship, there is some support for the association. A study conducted in Poland by Merecz and colleagues (1999) investigated the effects of each of the big five personality factors as modifiers of cardiovascular responses to occupational stress. Findings indicated that conscientiousness was the only personality variable that moderated systolic blood pressure reactivity in response to occupational stress. Furthermore, additional analysis suggested that conscientiousness was associated with heart rate reactivity when the participant was at the workplace, indicating that lower levels of conscientiousness were associated with increased stress, which was in turn associated with increased heart rate.

Conscientiousness has also been assessed in relation to affect and cortisol activity over a six day period (Nater et al., 2010). Although no main effect of conscientiousness was found on cortisol levels, differences were observed between individuals high and low in conscientiousness, with those high in conscientiousness exhibiting lower levels of cortisol in response to positive affect, suggesting conscientiousness to be an important factor in the stress response. Conscientiousness has also been assessed in relation to naturally occurring stressors. Within this research, Garcia-Banda et al. (2011) assessed cortisol levels as an indicator of physical stress over a stress day and a control day. Results indicated that there was a significant effect of

conscientiousness on stress reactivity, with greater levels of cortisol associated with high levels of conscientiousness (Garcia-Banda et al., 2011).

Alternative research has demonstrated that when faced with stressful tasks, individuals high in impulsiveness (an aspect of the self-control facet) showed more elevated heart rate reactivity compared to those who were less impulsive (Heponiemi, 2004). However, contradictory research from Allen et al. (2009) demonstrated that individuals high in impulsiveness showed a lesser increase in heart rate reactivity compared to those with higher levels of conscientiousness. In order to further explore this disparity, this current study aims to examine individuals high and low in conscientiousness in terms of their reactivity to stress when assessed physiologically.

Alongside reactivity to stress, exposure to stress may be influenced by conscientiousness. It has been suggested that individuals with higher levels of conscientiousness may encounter a lower number of stressors leading to less activation of biological systems and therefore the experience of better health (McEwen, 1998; Vollrath; 2000; Lee-Baggeley et al. 2005; O'Connor et al., 2009). Furthermore, exposure to stress has also been assessed in terms of perceived stress (please see the aforementioned research Penley & Tomaka, 2002; Gartland et al., 2012; Luo & Roberts, 2015). There appears to be some inconsistency in the findings relating to conscientiousness and perceived stress, with some evidence supporting a negative association between conscientiousness and perceived stress (Tyssen et al., 2007). Here, the nature of the stress event may be particularly important. Within this current study, perceived stress will be assessed via the measurement of cognitive appraisal both before and after the delivery of a laboratory-based stress task.

In some cases, it may be possible that perceiving high levels of stress is advantageous. By recognising the extent of the demands placed upon them, an individual may be better equipped to overcome and/or cope with the stressor. For example, in a study conducted on Norwegian medical trainees (Tyssen et al., 2007), research examining the effects of personality type on stress experienced during medical school training revealed that conscientiousness was an independent predictor of greater levels of stress. This research may provide an example of a situation in which perceiving high levels of stress is beneficial to the individual. For example, the perception of high levels of stress may have assisted the medical trainees to adapt their behaviour to the demands placed upon them, and thus enabled them to meet their goals leading to successful outcomes. Therefore, to summarise, findings suggest that high levels of

conscientiousness may be associated with the experience of fewer stressors; however when stressors are experienced they are perceived to be serious and acted upon appropriately.

4.1.5 Measuring stress

It is important to highlight that there is no standardised method of measuring stress. Measurements of stress frequently reflect the psychological, physiological, cognitive, emotional or behavioural aspects of stress that are of particular interest to the researcher. The experience of psychological stress is most often measured via questionnaire methods. A number of questionnaires are available that allow the measurement of perceived psychological stress attributable to different sources and situations. Some of the most popular stress measurement tools include the 'Daily Stress Inventory' (Brantley et al., 1987), the 'Perceived Stress Scale' (Cohen et al., 1983) and the 'Trier Inventory for the Assessment of Chronic Stress' (Schulz & Schlotz, 1999). Upon examination of these widely used questionnaires, it is apparent that it is possible to measure psychological stress that stems from a number of sources, such as the work place or the family. However, these techniques of measuring stress are almost always self-reported and therefore measure subjective or perceived levels of stress.

Measuring stress in terms of physiology enables measurement to be more objective in nature. The experience of events that are interpreted as being 'stressful' arouses activity within the sympathetic adrenal medullary response system (SAM) and hypothalamus-pituitary-adrenal (HPA) axis (Smeets et al., 2012). In regards to the sympathetic adrenal medullary response system (SAM), when stress is experienced, the brain instructs the adrenal gland to release noradrenaline, which in turn activates the body's organs. Simultaneously, the brain instructs the adrenal medulla to release adrenaline which is transported within the blood stream. The presence of adrenaline further prepares the body for a response, which is often referred to as the 'fight' or 'flight' response. Likewise, when stress is experienced, activation within the hypothalamic-pituitary-adrenal axis response system (HPA) may be elicited. To begin with, corticotrophin releasing factor (CRF) is released from the hypothalamus. Once received by the pituitary gland, adrenocorticotrophic hormone (ACTH) is released. This hormone then travels throughout the circulatory system to reach the adrenal cortex. Here, glucocorticoid cortisol is produced as a result. The presence of cortisol allows the body's energy sources to become more accessible, through means such as enabling

energy stored within the liver and muscles to be turned into glucose for rapid use of the brain and muscles.

As a result of these stress processes, the heart begins to beat more rapidly, the blood vessels constrict to assist the movement of blood from the extremities to the core body, breathing rate accelerates, the eyes dilate and digestive system activity ceases to allow blood to move to the muscles (Abraham et al., 2008). These fluctuations in hormonal activity and the autonomic system consequently provide access points for physiological stress to be measured. Additionally, the measurement of these changes can be completed fairly quickly and with ease. For example, blood pressure and heart rate are able to be measured with the use of either a digital blood pressure monitor or manual device in a number of minutes, whilst cortisol and catecholamines (adrenaline and noradrenaline) can be measured via blood and urine samples. More recently, salivary alpha-amylase has been examined as an indicator of level of activity within the sympathetic nervous system (Nater et al., 2006), and cortisol levels have been measured via saliva samples (Kirschbaum et al., 1993), providing additional as well as more accessible and acceptable means of measuring stress to the individual.

4.1.6 Stress induction

In order to induce stress, a number of experimental procedures have been designed to activate these human stress systems. The most widely used procedures are the Cold Pressor Test (CPT; e.g., Lovallo, 1975; Mitchell et al., 2004) and the Trier Social Stress Test (TSST; Kirschbaum et al., 1993) which is considered the gold standard procedure among stress protocols (Smeets et al., 2012). In terms of their procedures, the Cold Pressor Test requires participants to immerse their hand into ice cold water (typically 0-5 degrees Celsius) for a number of trials lasting up to a maximum of three minutes long. Unlike the Cold Pressor Test, the Trier Social Stress Test requires participants to deliver a five minute long speech (for example, an imitation job interview) as well as perform mental arithmetic for five minutes in front of an audience, whilst being audio and video reordered. Although both procedures have been shown to elicit acute stress responses, the extent of reactivity within the SAM and HPA axes differs between procedures (Smeets et al., 2012). For example, the Cold Pressor Test results in robust activation of the SAM axis, yet only minor HPA axis activation, whereas the Trier Social Stress Test produces robust activation of the HPA axis whilst only causing acute activation of the SAM axis (Smeets et al., 2012).

It therefore seems that the nature of the task at hand may be responsible for the differences observed in the SAM and HPA axes activations. The Cold Pressor Task is a physical task which may cause mild physical pain and discomfort, whereas the Trier Social Stress Test is a psychological task, which may cause psycho-evaluative threat. Relatedly, the duration of the procedure may also influence reactivity. The Cold Pressor Test is relatively short lasting only three minutes in duration, whilst the Trier Social Stress Test is much longer in comparison lasting up to fifteen minutes. In terms of time, it has been proposed that physical stress requires an immediate bodily reaction, and thus generates an accelerated SAM axis response (Ulrich-Lai and Herman, 2009), whereas psychosocial stress requires evaluation leading to cognitive appraisals that may trigger stress responses via the HPA axis, and thus response time is lengthier (Dickerson & Kemeny, 2004; Ulrich-Lai & Herman, 2009).

As a result of the findings that both physical and psychosocial stress seem to be important for activating both stress response systems, the Cold Pressor Task has been developed to include a psychosocial aspect. Within this development, participants are required to perform the hand immersion task whilst being observed by an experimenter of the opposite sex as well as video recorded (i.e., the Socially Evaluated Cold Pressor Test or SECPT; Schwabe et al., 2008). Results revealed that the Socially Evaluated Cold Pressor Test did produce a significant increase in activation within the HPA axis when compared to the original Cold Pressor Test (Schwabe et al., 2008). However, Smeets et al. (2012) argued that although the results were an improvement upon those elicited by the previous protocol, the level of activation was smaller than the one typically produced by the Trier Social Stress Test. Although the Trier Social Stress Test yields superior results, it has limitations in terms of its practicality. The requirement of an audience is costly and can be impractical in terms of organisation and scheduling. Therefore, Smeets et al. (2012) proposed to develop a stress activating procedure that combined both the physical aspects of the Cold Pressor Test and the psychosocial aspects of the Trier Social Stress Test, which could be delivered in a cost-effective, timely manner that reduced the burden on researchers by allowing it to be performed by one experimenter alone. The developed procedure was named the Maastricht Acute Stress Test (MAST; Smeets et al., 2012). Results from its evaluation revealed that when compared to the Cold Pressor Test, the Maastricht Acute Stress Test produced similar activity within the SAM (systolic and diastolic blood pressure) and superior activity within the HPA axis (salivary cortisol responses). When compared to the Trier Social

Stress Test, results indicated similar findings in both domains. Therefore, a brief yet effective stress protocol was produced (specific procedure details can be found in the Methods section of this chapter).

To summarise, the current study examined the effects of a laboratory based stress protocol on stress reactivity in individuals high and low in conscientiousness. Given the mixed findings of previous studies, no specific hypotheses were generated. Specifically, the following research questions were explored:

i. What is the relationship between conscientiousness and (a) stress appraisals, and (b) state anxiety in response to a laboratory-based stress task?

ii. What is the relationship between conscientiousness and (a) blood pressure and (b) heart rate in response to a laboratory-based stress task?

iii. What is the relationship between stress appraisals and blood pressure in individuals high and low in conscientiousness in response to a laboratory-based stress task, when conscientiousness is assessed in terms of total conscientiousness and the lower order facets of conscientiousness?

4.2 Method

4.2.1 Participants and Design

This study employed an adult sample, recruited via emails sent to University of Leeds staff, posters and flyers distributed across the university campus, advertisements on social media as well as in person. Participants completed the Chernyshenko Conscientiousness Scales (CCS; Green et al., 2015) here and elsewhere as a screening measure, with participants indicating the highest and lowest levels of conscientiousness invited to participate in the study. Low conscientiousness was classified as scores equal to 2.72 or below, and high conscientiousness was classified as scores equal to 3.17 or above, based on top and bottom 25% of the sample. The sample consisted of 85 women and 16 men (*N* = 101), with an average age of 28 years (range = 18-63 years). The sample were largely white ethnicity (87.1%) with the remaining ethnicities (12.9%) including Chinese, Indian, Pakistani, Afro-Caribbean and mixed ethnicities. Sixty-six of the participants were either in education or unemployed, with the remaining thirty-five either employed or retired. The study received ethical approval from the Institute of Psychological Sciences, University of Leeds Ethics Committee (Ref: 14-0016). Participants were compensated with a £15 Love2shop voucher for their time.

4.2.2 Equipment

4.2.2.1 Refrigerated water bath

A water bath, electrical immersion cooler and circulation pump (Lab companion refrigerated bath circulator – JEIO tech model RW – 0525G) were used to contain the water and to keep the water at a constant temperature of 2.0 degrees Celsius.

4.2.2.2 Systolic and Diastolic Blood Pressure Monitor

An upper-arm blood pressure monitor (Omron M7) was used to measure systolic blood pressure, diastolic blood pressure and heart rate. This device has been clinically validated in terms of reliability and accuracy by major organisations such as the British Hypertension Society (Omron, 2015).

4.2.3 Measures

4.2.3.1 Screening Questionnaire

Please see chapter 3 for details.

4.2.3.2 State Anxiety

State anxiety was assessed via the six-item short-form version (STAI-6; Marteau & Bekker, 1992) of the State-Trait Anxiety Inventory (STAI; Spielberger et al., 1983). This scale measures state anxiety (anxiety felt at a particular moment in time). The STAI-6 has demonstrated acceptable reliability and has obtained similar results to that of the twenty-item STAI from individuals with normal and raised levels of anxiety (Marteau & Bekker, 1992). Participants were instructed to read each statement and then indicate how they felt at that particular moment by circling the appropriate response. Furthermore, participants were instructed not to spend too much time on any one statement but to give the answer which seemed to describe their present feelings best. Items included 'I feel calm', 'I am tense', 'I feel upset', 'I am relaxed', 'I feel content' and 'I am worried'. Items were scored on a four point Likert scale with responses ranging from 'not at all' (1) to 'very much' (4). Responses to items 1, 4 and 5 were reversed so that a high score indicated a greater level of anxiety (Baseline STAI Measure Cronbach's $\alpha = .75$, Post Task STAI Measure Cronbach's $\alpha = .83$).

4.2.3.3 Appraisals

Appraisals were measured via modified versions of The Stressor Appraisal Scale (SAS; Schneider, 2008; Gartland et al., 2012). This scale was delivered in anticipation of the MAST and post-participation of the MAST, which was described to participants as a 'challenging task'. Some items were deemed irrelevant to the task and were therefore omitted; and some items were modified to include the word 'task' as appropriate. The scale was also modified so that it was phrased in the past tense, making it suitable to be delivered post-MAST.

4.2.3.3.1 Appraisals Pre-MAST version

Participants indicated how threatening they thought the 'challenging task' was going to be (primary appraisals) and how well they thought they would cope with the task

(secondary appraisals). Items were scored on a seven point Likert scale with responses ranging from 'not at all' to 'to a very large extent'. The primary appraisal items included (1) 'How threatening do you think the task will be?', (2) 'How demanding do you think the task will be?', (3)'How stressful do you think the task will be? (4) 'To what extent do you think you will need to exert yourself to deal with the stress?' and (5) 'How much effort (mental or physical) do you think the situation will require you to expend?' (Five items; Cronbach's α = .86). The secondary appraisal items included (1) 'How well do you think you can manage the demands imposed on you by the task?', (2) 'How able do you think you are to cope with the task?' and (3) 'How well do you think you will perform on the task?' (Three items; Cronbach's α = .84). The total score for each scale was calculated to provide an overall primary appraisal score and an overall secondary appraisal score. A baseline appraisal ratio was calculated by dividing the primary appraisal score by the secondary appraisal score. A high score (i.e., high ratio) indicates a situation in which perceived demands outweigh perceived resources (Gartland et al., 2013).

4.2.3.3.2 Appraisals Post-MAST version

Participants indicated how threatening they found the task (primary appraisals) and how well they thought that they had coped (secondary appraisals). Items were scored on a seven point Likert scale with responses ranging from 'not at all' to 'to a very large extent'. The primary items included (1) 'How threatening did you find the task to be?', (2)'How demanding was the task?', (3) 'How stressful did you find the task to be?', (4) 'To what extent did you need to exert yourself to deal with the stress?' and (5) 'How much effort (mental or physical) did the situation require you to expend?' (Five items; Cronbach's α = .90). The secondary items included (1) 'How well did you manage the demands imposed on you by the task?', (2) 'How able were you to cope with the task?' and (3) 'How well did you perform in dealing with the task? (Three items; Cronbach's α = .91). The total score for each scale was calculated to provide an overall primary appraisal score and an overall secondary appraisal score. A Post Task appraisal ratio was calculated by dividing the primary appraisal score by the secondary appraisal score. A high score (i.e., high ratio) indicates a situation in which perceived demands outweigh perceived resources (Gartland et al., 2013).

4.2.3.4 Blood Pressure and Heart Rate

Systolic blood pressure (SBP), diastolic blood pressure (DBP) and heart rate (HR) were measured using an Omron M7 upper-arm blood pressure monitor. SBP, DBP and HR were each measured at baseline (which began after a ten minute rest period), immediately post-MAST procedure and then ten minutes post-MAST procedure. At baseline, blood pressure and heart rate were measured 3 times. The first measure was discarded (to allow for blood pressure rising in anticipation of having blood pressure measured) and an average of measures two and three were calculated to provide a baseline score. For both the post-MAST and ten minutes post-MAST measures blood pressure and heart rate were measured twice, with an average of these scores calculated to provide a post-MAST and post-relaxation score. Next SBP and DBP reactivity and recovery scores were computed for each participant. Blood pressure reactivity was calculated by subtracting the baseline score from the post-MAST score and blood pressure recovery was calculated by subtracting the post-relaxation score from the baseline score (Menkes et al., 1989).

4.2.4 Procedure (including the Maastricht Acute Stress Test (MAST))

Participants were asked to complete an online screening questionnaire comprising a demographic questionnaire, the Chernyshenko Conscientiousness Scales (CCS; Green et al., 2015), and one other questionnaire that is not discussed here. Participants' responses to the CCS were calculated to produce an overall score for conscientiousness. Individuals, who were deemed as scoring low on conscientiousness (bottom 25% of the sample), i.e., with a score equal to or lower than 2.72, or high on conscientiousness (top 25% of the sample), i.e., with a score equal to or higher than 3.17, were invited via email to visit the Laboratory for Stress and Health Research (STAR lab) at the University of Leeds. Details of the MAST procedure were not divulged to participants at this stage, they were simply informed that they would be required to complete a challenging task that would last for no longer than twelve minutes. Participants were however informed that there was a chance that this study may cause some physical discomfort and may cause them to feel stressed. Prior to partaking, participants were informed that they should refrain from consuming alcohol, exercising excessively, or taking any pain medication (e.g. paracetemol, ibuprofen) on the day of testing. Alongside this, participants were asked to re-arrange their appointment if they were feeling unwell, e.g. any cold or flu symptoms.

Once participants arrived at the laboratory, they were led into a testing cubicle. The researcher then asked the participant to provide informed consent and answered any questions that the participant had in relation to this. The researcher then informed the participant that they would be video-recorded and asked them to indicate that they consented to this. Participants were then asked to indicate whether they had consumed any pain medication on the given day, and were excluded from the study if they indicated that they had. Participants were not informed of any details of the task at this stage, if they asked any questions in relation to the task the researcher responded with the statement *"It will involve a physically and mentally challenging task, and further details will be given just before starting".* Participants were then asked to rest in the test cubicle for ten minutes, to enable blood pressure and heart rate to stabilise. Participants SBP, DBP and HR were then measured three times by the researcher. The first measure was discarded, with an average of the second and third measures used to calculate the baseline measure.

Participants were then asked to move to a different testing cubicle which housed the cold pressor equipment and a computer for the preparation period. Participants were shown a PowerPoint presentation that was adapted from (Smeets et al., 2012) explaining what the upcoming task would involve. To begin with, participants were asked to read all of the instructions carefully, and to press the space bar to move on to the next page of the PowerPoint presentation. Next, participants were told that the total duration of the task was approximately twelve minutes, that the water bath beside them contained ice cold water, that during the task they would be asked to place their hand including the wrist joint into the water several times, and in between these 'trials' they would have to perform some mental arithmetic.

The following instructions were then presented: During trials in which you have to place your hand in the water, you will see the instruction "HAND IN WATER" on the screen. Keep your hand as relaxed as possible and try to not make a fist with your hand. Try to hold your hand in the water until you are instructed to remove it. In that case, you will read "REMOVE HAND" on the screen. The computer will randomly decide how long you have to immerse your hand in the water. This will last a maximum of 90 seconds. The duration of the periods in between the hand immersion trials will also be randomly chosen by the computer. These periods will last for a minimum of 45 seconds. When you do not have to hold your hand in the water you will be asked to count backwards as fast and accurately as possible in steps of 17 from the number 2043. The experimenter will

inform you what number you need to start from. Example: counting backwards in steps of 2 starting at 50 would imply: 50 – 48 – 46 – 44 – 42 – 40 – … Whenever you make an error, you will be told by the experimenter and you will have to start over. Please start counting immediately after you see this instruction on the screen: Count backwards in steps of 17. Next, participants were presented with the following information: Throughout this task your performance will be video-recorded. These recordings will afterwards be used to analyse your facial expressions and to compare your performance to other participants. It is therefore essential that you keep your gaze directed at the video camera throughout the tasks. Please indicate on the consent form whether or not you agree with the recordings. Even more important, whilst this procedure will not cause you any harm, it can be experienced as unpleasant and even painful. If the task becomes too uncomfortable, you may remove your hand from the water. As in any other study, you have the right to withdraw from the task and end your participation in this study at any time. If you have any questions, please ask your experimenter NOW. The researcher than answered any questions the participant had in relation to the MAST procedure.

Following the PowerPoint presentation, participants were asked to complete the stressor appraisal scale (Pre-MAST version) and the state anxiety inventory. The researcher then asked the participant if they were happy to continue and instructed them to press the space bar whenever they were ready to begin the task (MAST procedure).

The researcher pressed the record button on the video-recording equipment; however the recording equipment was not actually turned on and was not recording the participant. Although participants were informed that the computer would randomly decide the length of time of the trials, the timing of the trials was fixed and identical for each participant. The order and timings of these trials are displayed in Figure 4.1. The researcher remained seated in the corner of the testing cubicle, holding a clip board with a list of correct responses throughout the procedure and did not look directly at the participant throughout the procedure. Within the MAST, if the participant made an error within the mental arithmetic trials, the researcher responded *"No, that is incorrect. Please start over from 2043".* Alongside this, if the participant removed their hand from the water bath, the researcher instructed the participant to "*Place your hand back in the water as soon as you feel able to".* Following the fifth hand immersion trial, participants were informed that the task was now complete. Participants SBP, DBP and HR were then

measured immediately post-MAST. Participants were then asked to complete the stressor appraisal scale (Post-MAST version) and the state anxiety inventory (STAI). Participants were then asked to rest in the testing cubicle for a period of ten minutes. The procedure ended with the researcher measuring SBP, DHP and HR for the final time (ten minutes after their post-MAST measurement). Please see Figure 4.2 for a visual representation of the study procedure.

Duration	Task
90 seconds	Hand Immersion Trial
45 seconds	Mental Arithmetic Trial
60 seconds	Hand Immersion Trial
60 seconds	Mental Arithmetic Trial
60 seconds	Hand Immersion Trial
90 seconds	Mental Arithmetic Trial
90 seconds	Hand Immersion Trial
45 seconds	Mental Arithmetic Trial
60 seconds	Hand Immersion Trial

Figure 4.1. Order and duration of trials of the MAST procedure

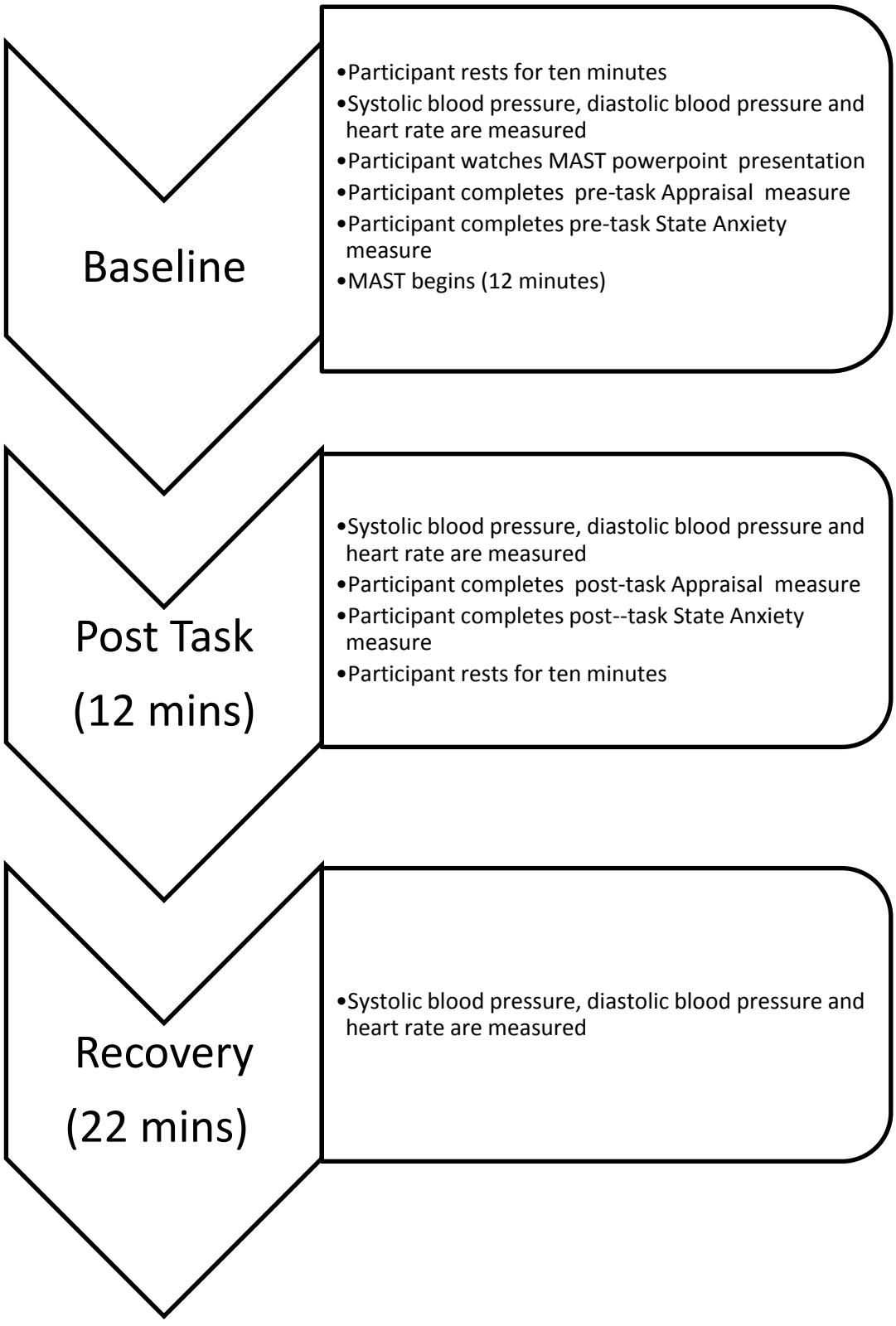

Figure 4.2. A flow chart representation of the study procedure

4.2.5 Statistical analysis

Descriptive statistics and Pearson product moment correlation coefficients were computed in order to examine the relationships between the study variables. Repeated measures ANOVA were computed to test the main effects of conscientiousness group (fixed factor) on primary and secondary appraisals, the appraisal ratio and state anxiety (dependent variables) and whether any significant interactions between these variables were present. Next, repeated measures ANCOVA (with age as a covariate) were computed to test the main effects of conscientiousness group (fixed factor) on systolic and diastolic blood pressure reactivity and recovery (dependent variables). Lastly, hierarchical linear regression was utilised to examine the effects of appraisals on blood pressure reactivity and recovery in conscientiousness groups. All analyses were performed in SPSS version 21.0.

Independent samples t-test revealed that the groups were significantly different from one another on scores of conscientiousness, t (99) = 19.83, $p < .01$. The results of ANOVA revealed no evidence of main effects of conscientiousness group (low vs. high) on BMI, but there was a main effect of conscientiousness group on age, F (94) = 6.73, $p < .01$, such that individuals in the high conscientiousness group were older than individuals in the low conscientiousness group. Therefore, age was controlled for in subsequent analyses examining physiological measures.

4.3 Results

4.3.1 Descriptive Statistics

Descriptive statistics were calculated for each of the study variables and are presented in Table 4.1. Inspection of the means indicated that scores of primary appraisal were similar between individuals low and high in conscientiousness, with individuals low in conscientiousness scoring only slightly higher on primary appraisal at baseline (low C mean = 4.51, high C mean= 4.33) and only slightly lower post-MAST (low C mean = 4.97, high C mean = 5.00). For secondary appraisal at baseline, scores were very similar across conscientiousness groups (low C mean = 3.98, high C mean = 4.00), but were slightly different from secondary appraisals post-MAST, with individuals high in conscientiousness reporting a lower scores on ability to cope with the MAST procedure (low C mean = 3.89, high C mean = 3.47). For the appraisal ratio, scores at baseline were

very similar across conscientiousness groups (low C mean = 1.28, high C mean = 1.24), yet differed somewhat post-MAST (low C mean = 1.49, high C mean = 1.91), suggesting that for those individuals high in conscientiousness, perceived demands outweighed perceived resources to a greater extent. For state anxiety (STAI), baseline scores were indistinguishable between conscientiousness groups (low C mean = 9.47, high C mean = 9.46), yet post-MAST individuals low in conscientiousness reported higher scores (low C mean = 12.68, high C mean = 11.84), indicating greater levels of anxiety following the MAST procedure.

In regards to blood pressure activity, systolic blood pressure reactivity appeared to be slightly greater in the high conscientious group compared to the low (low C mean = 7.93 mmHg, high C mean = 8.70 mmHg), and systolic blood pressure recovery was greater in the low conscientious group compared to the high (low C mean = 1.24 mmHg, high C mean = .90 mmHg), suggesting that those individuals high in conscientiousness had a greater increase in systolic blood pressure in response to the MAST procedure, but also a quicker return to baseline blood pressure. For diastolic blood pressure, reactivity appeared to be slightly greater in the high conscientious group compared to the low (low C mean = 7.17 mmHg, high C mean = 7.91 mmHg), and again, a smaller recovery score could be seen for the high conscientious group suggesting a faster return to baseline blood pressure. In addition, for the total sample, scores indicated that systolic blood pressure scores increased slightly more than diastolic blood pressure scores (systolic reactivity mean = 8.33 mmHg, diastolic reactivity mean = 7.56 mmHg).

4.3.2 Preliminary correlational analysis

The correlations between conscientiousness and its facets, appraisals and state anxiety were assessed and are presented in Table 4.2. As expected, the analysis revealed that primary appraisals were negatively correlated to secondary appraisals; and positively correlated to the appraisal ratios. Unexpectedly, the analysis revealed that conscientiousness and each of its facets were not correlated to primary appraisals, secondary appraisals, the appraisal ratios or state anxiety, which is somewhat inconsistent with previous research (Gartland et al., 2012; Booth et al., 2006).

What is the relationship between conscientiousness and (a) stress appraisals, and (b) state anxiety in response to a laboratory-based stress task?

Repeated measures ANOVA revealed no evidence for a main effect of conscientiousness group on appraisals or state anxiety. Results revealed that there was a main effect of time on primary appraisals (F (97) = 37.81, $p < .01$), secondary appraisals (F (97) = 4.94, $p < .05$), the appraisal ratios (F (95) = 22.30, $p < .01$) and state anxiety (F (96) = 57.19, $p < .01$), indicating that appraisals and state anxiety scores changed as a result of the MAST procedure. Primary appraisal scores increased, suggesting that participants found the MAST procedure to be more stressful than they anticipated pre-task. Secondary appraisal scores decreased suggesting that participants reported feeling less able to cope and manage the MAST procedure than they had anticipated at baseline. The appraisal ratio increased indicating that perceived demands outweighed perceived resources to a greater extent in response to the MAST. Scores of state anxiety increased indicating greater feelings of anxiety following the delivery of the MAST. However, no conscientiousness group*time interactions were found for appraisals or state anxiety. Therefore, individuals in the low and high conscientiousness groups did not differ significantly in terms of their stress appraisals or in terms of state anxiety over time.

What is the relationship between conscientiousness and (a) blood pressure and (b) heart rate in response to a laboratory-based stress task?

The results of ANCOVA (with age as a covariate) revealed no evidence for a main effect of conscientiousness group on systolic blood pressure, diastolic blood pressure or heart rate. Results revealed that for systolic blood pressure there was a marginally significant effect of time, F (2, 95) = 2.76, p = .07, however there was no significant time*age interaction or time*group interaction. For diastolic blood pressure there was no significant effect of time. Alongside this there was no significant time*age interaction or time*group interaction. For heart rate there was a significant effect of time, F (2, 95) = 4.50, $p < .01$. However there was no significant time*age interaction or time*group interaction. Therefore, those categorised as high or low in conscientiousness did not differ significantly in terms of their physiological responses to the MAST procedure.

What is the relationship between stress appraisals and blood pressure in individuals high and low in conscientiousness in response to a laboratory-based stress task, when conscientiousness is assessed in terms of total conscientiousness and the lower order facets of conscientiousness?

Correlation coefficients between the main study variables were assessed in individuals low and high in conscientiousness. Results are presented in Table 4.3 and Table 4.4. For individuals low in conscientiousness (Table 4.3) none of the appraisal measures were significantly associated with systolic or diastolic blood pressure reactivity or recovery measures. However, for those high in conscientiousness (Table 4.4) primary appraisals measured at baseline (Time 1) were significantly negatively associated with systolic blood pressure reactivity (r = - .29) and systolic blood pressure recovery (r = - .40), suggesting that high primary appraisals, i.e., a greater feeling of threat and stress, were associated with a lower increase in systolic blood pressure as well as with a faster recovery to baseline systolic blood pressure. In addition, a negative association was observed seen between primary appraisals measured post-MAST (Time 2), however this association did not reach a level of statistical significance. Further scrutiny of Table 4.4 revealed that neither primary appraisal at baseline nor primary appraisal post-MAST was significantly associated with diastolic reactivity or recovery scores.

Next, the correlations were further investigated via hierarchical linear regression to assess whether appraisals could predict blood pressure scores, and whether these results differed in those scoring low and high in conscientiousness. As the sample was recruited based upon score on conscientiousness, and did not include a continuous range of scores, results for each group were analysed separately. Results are presented in Table 4.5 for individuals low in conscientiousness and in Table 4.6 for individuals high in conscientiousness. Primary appraisals at baseline and post-MAST were assessed as predictors, with systolic blood pressure reactivity and recovery scores assessed as dependent variables. Age was entered as a control variable in step 1 of all analyses, with the appraisal score entered in step 2 of the model. To begin with, total conscientiousness was assessed. Results indicated that for those low in conscientiousness, appraisals measured at baseline and post-MAST were unable to predict systolic blood pressure reactivity or recovery. Conversely, for those high in conscientiousness, primary appraisal at baseline was marginally able to predict systolic

blood pressure reactivity (β = - .27, p = .06), and was able to predict systolic blood pressure recovery (β = - .38, p < .01). A summary of the significant predictors can be found in Table 4.7.

The same analysis was repeated for each facet of conscientiousness, with participants being classified as scoring high or low on each facet (above or below the mean score). A summary of these analyses are presented in Table 4.8. Results indicated that primary appraisals were able to predict blood pressure reactivity and recovery on thirteen occasions in those scoring high in conscientiousness but were only able to significantly predict blood pressure reactivity and recovery twice in those scoring low in conscientiousness, suggesting that this effect was also captured when examining conscientiousness at facet level. Primary appraisals measured at baseline emerged as being particularly important for those scoring high in conscientiousness.

Multiplicative interaction terms were calculated for conscientiousness group scores and primary appraisal measures, however no significant interactions were observed when these variables were entered into the regression model.

Table 4.1. Descriptive statistics for all study variables.

	Low C (N = 48)		High C (N = 53)		Total (N = 101)	
	Mean	SD	Mean	SD	Mean	SD
Conscientiousness	2.56	.18	3.30	.20	2.95	.42
Order	2.42	.54	3.32	.50	2.89	.68
Virtue	2.57	.42	3.17	.44	2.88	.52
Traditionalism	2.23	.36	2.97	.41	2.62	.54
Self-Control	2.56	.45	3.27	.39	2.93	.55
Responsibility	2.71	.31	3.48	.27	3.11	.48
Industriousness	2.56	.18	3.60	.32	3.24	.56
Primary Appraisal T1	4.51	1.14	4.33	1.11	4.42	1.12
Primary Appraisal T2	4.97	1.47	5.00	1.32	4.99	1.36
Secondary Appraisal T1	3.98	1.18	4.00	1.12	3.99	1.14
Secondary Appraisal T2	3.89	1.38	3.47	1.51	3.67	1.46
Ratio T1	1.28	.74	1.24	.79	1.26	.76
Ratio T2	1.49	.81	1.91	1.31	1.71	1.11
STAI T1	9.47	2.22	9.46	2.55	9.46	2.39
STAI T2	12.68	3.28	11.84	3.49	12.24	3.40
Systolic T1	101.14	12.31	106.16	14.35	103.72	13.57
Systolic T2	109.19	14.37	114.85	18.75	112.14	16.95
Systolic T3	102.51	12.63	107.06	16.26	104.88	14.73
Diastolic T1	64.54	8.61	69.35	11.23	67.02	10.28
Diastolic T2	71.93	10.79	77.26	13.29	74.70	12.39
Diastolic T3	68.44	9.33	71.97	11.38	70.28	10.55
Heart Rate T1	72.19	12.51	72.16	12.26	72.17	12.32
Heart Rate T2	69.28	10.94	69.22	12.28	69.24	11.60
Heart Rate T3	69.09	10.72	68.36	11.43	68.71	11.04
Systolic Reactivity	7.93	10.58	8.70	12.62	8.33	11.64
Systolic Recovery	1.24	7.92	.90	8.59	1.07	8.24
Diastolic Reactivity	7.17	9.02	7.91	10.97	7.56	10.04
Diastolic Recovery	3.68	6.46	2.62	7.90	3.13	7.23

Note: T1 = Baseline, T2 = Post-MAST, T3 = 10 minutes Post-MAST. STAI = State Anxiety

Table 4.2. Pearson product-moment correlation coefficients and Cronbach's alpha for conscientiousness, state anxiety and appraisals (*N* = 98 - 101)

		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Conscientiousness	__														
2	Industriousness	.81*	__													
3	Order	.75*	.48*	__												
4	Traditionalism	.77*	.56*	.44*	__											
5	Self-Control	.74*	.50*	.57*	.52*	__										
6	Responsibility	.86*	.75*	.52*	.60*	.60*	__									
7	Virtue	.61*	.44*	.27*	.43*	.18	.52*	__								
8	STAI Baseline	-.01	-.03	-.10	.09	.05	.06	-.08	__							
9	STAI Post-Task	-.17	-.09	-.14	-.06	-.12	-.18	-.18	.25*	__						
10	Primary Appraisal T1	-.12	-.12	-.05	-.07	-.12	-.11	-.08	.58*	.38*	__					
11	Primary Appraisal T2	.01	.07	.06	-.05	.01	.00	-.08	.39*	.54*	.70*	__				
12	Secondary Appraisal T1	.01	.15	.01	-.07	-.04	.02	-.04	-.34*	-.20*	-.30*	-.14	__			
13	Secondary Appraisal T2	-.11	-.11	-.03	-.11	-.09	-.12	-.06	-.15	-.36*	-.24*	-.33*	.47*	__		
14	Appraisal Ratio T1	-.07	-.16	-.03	.10	-.02	-.07	.03	.43*	.32*	.65*	.44*	-.75*	-.41*	__	
15	Appraisal Ratio T2	.16	.18	.10	.13	.14	.16	-.08	.32*	.46*	.39*	.59*	-.39*	-.81*	.54*	__
	Cronbach's α	.84	.90	.90	.83	.85	.81	.80	.75	.83	.86	.90	.84	.91	__	__

Note: * = the correlation coefficients were significant at the .01 level (two-tailed), T1 = Baseline, T2 = Post – MAST

Table 4.3. Pearson product-moment correlation coefficients for Appraisals and BP Reactivity and Recovery in individuals Low in Conscientiousness.

		1	2	3	4	5	6	7	8	9	10
1	Primary Appraisal T1	__									
2	Primary Appraisal T2	.75*	__								
3	Secondary Appraisal T1	-.17	.08	__							
4	Secondary Appraisal T2	-.07	-.06	.41*	__						
5	Appraisal Ratio T1	.63*	.41*	-.73*	-.30*	__					
6	Appraisal Ratio T2	.39*	.59*	-.17	-.76*	.36*	__				
7	SBP Reactivity	-.13	-.05	-.24	.06	.10	-.10	__			
8	SBP Recovery	-.01	.09	.10	.10	-.04	-.06	.49*	__		
9	DBP Reactivity	-.12	.05	-.06	.11	-.02	-.08	.80*	.32*	__	
10	DBP Recovery	-.05	-.01	.06	-.18	-.03	.17	.30*	.44*	.40*	__

Note: SBP = systolic blood pressure, DBP = diastolic blood pressure; Primary Appraisal T1 = Baseline, Primary Appraisal T2 = Post –MAST; * = $p < .01$

Table 4.4. Pearson product-moment correlation coefficients for Appraisals and BP Reactivity and Recovery in individuals High in Conscientiousness.

		1	2	3	4	5	6	7	8	9	10
1	Primary Appraisal T1	__									
2	Primary Appraisal T2	.65*	__								
3	Secondary Appraisal T1	-.43*	-.38*	__							
4	Secondary Appraisal T2	-.41*	-.60*	.54*	__						
5	Appraisal Ratio T1	.67*	-.77*	-.77*	-.52*	__					
6	Appraisal Ratio T2	.46*	-.56*	-.56*	-.86*	.67*	__				
7	SBP Reactivity	-.29*	-.27	.19	.11	-.13	-.11	__			
8	SBP Recovery	-.40*	-.24	.09	.08	-.16	.08	.55*	__		
9	DBP Reactivity	-.26	-.24	.07	.11	-.15	-.07	.77*	.46*	__	
10	DBP Recovery	-.12	-.18	-.14	-.06	.04	.05	.42*	.54*	.57*	__

Note: SBP = systolic blood pressure, DBP = diastolic blood pressure; Primary Appraisal T1 = Baseline, Primary Appraisal T2 = Post –MAST; * = $p < .01$

Table 4.5. Hierarchical linear regression analyses testing the effects of baseline primary appraisal and post-MAST primary appraisal on systolic blood pressure reactivity and recovery in those individuals low in conscientiousness.

		β step 1	β step 2	ΔR^2 for step	Total R^2
SBP Reactivity					
Step 1	Age	.05	.04	.00	
Step 2	Baseline PA		-.12	.02	.02
SBP Recovery					
Step 1	Age	.03	.03	.00	
Step 2	Baseline PA		-.01	.00	.00
SBP Reactivity					
Step 1	Age	.09	.08	.01	
Step 2	Post-MAST PA		-.02	.01	.01
SBP Recovery					
Step 1	Age	-.04	.00	.00	
Step 2	Post-MAST PA		.09	.01	.01

Note: * = p < .01, PA = Primary Appraisal, MAST = Maastricht Acute Stress Test

Table 4.6. Hierarchical linear regression analyses testing the effects of baseline primary appraisal and post-MAST primary appraisal on systolic blood pressure reactivity and recovery in those individuals high in conscientiousness.

		β step 1	β step 2	ΔR^2 for step	Total R^2
SBP Reactivity					
Step 1	Age	.16	.08	.03	
Step 2	Baseline PA		$-.27^{+}$	.07	.09
SBP Recovery					
Step 1	Age	.20	.10	.04	
Step 2	Baseline PA		-.38*	.13	.17*
SBP Reactivity					
Step 1	Age	.17	.09	.03	
Step 2	Post-MAST PA		-.24	.05	.08
SBP Recovery					
Step 1	Age	.25	.18	.06	
Step 2	Post-MAST PA		-.18	.03	.09

Note: * = p < .01, $^{+}$ = p = .06, PA = Primary Appraisal, MAST = Maastricht Acute Stress Test

Table 4.7. A summary of primary appraisals as predictors of systolic blood pressure reactivity and recovery in high and low conscientiousness groups.

		Primary Appraisal Baseline		Primary Appraisal Post Task	
		High C	Low C	High C	Low C
Total	SBP Reactivity	✓	×	×	×
Conscientiousness	SBP Recovery	✓	×	×	×

Note: SBP = systolic blood pressure. Please note that High C – SBP Reactivity significance was marginal (p = .06)

Table 4.8. Primary appraisals as predictors of blood pressure reactivity and recovery in high and low conscientiousness facet groups.

		Primary Appraisal Baseline		Primary Appraisal Post Task	
		High C	Low C	High C	Low C
Industriousness	SBP Reactivity	✓	×	×	×
	SBP Recovery	✓	×	×	×
Self-Control	SBP Reactivity	✓	×	✓	×
	SBP Recovery	✓	×	×	×
Order	SBP Reactivity	✓	×	×	×
	SBP Recovery	✓	×	×	×
Responsibility	SBP Reactivity	×	×	×	×
	SBP Recovery	✓	×	×	×
Traditionalism	SBP Reactivity	×	×	×	×
	SBP Recovery	✓	×	×	×
Virtue	SBP Reactivity	×	✓	×	×
	SBP Recovery	×	✓	×	×

Note: SBP = systolic blood pressure

4.4 Discussion

The present study was undertaken to investigate the effects of conscientiousness on stress reactivity. Firstly, the research question 'What is the relationship between conscientiousness and (a) stress appraisals, and (b) state anxiety in response to a laboratory-based stress task?' was addressed. Results revealed that total conscientiousness and its facets were not correlated with primary appraisals, secondary appraisals, the appraisal ratio or state anxiety. Furthermore, no main effects of conscientiousness group on appraisals or state anxiety were observed. Likewise, no interactive effects between conscientiousness and appraisals or state anxiety were found. As a result, this study did not find evidence to support a relationship between conscientiousness and (a) appraisals or (b) state anxiety.

These results were inconsistent with the previous finding that conscientiousness was significantly negatively correlated with primary appraisals of a stressful task whist significantly positively correlated with secondary appraisals (Penley and Tomaka., 2002). Similarly, these results did not support the finding that particular facets of conscientiousness were significantly associated with primary and secondary appraisals (Gartland et al., 2012). One possible explanation for the discrepancies in findings may be due to the differing types of stressful situations and tasks that were assessed (e.g., daily hassle versus. stress inducing procedure). Additionally, no evidence was found to support the significant negative association between conscientiousness and state anxiety (Booth et al., 2006).

Secondly, the research question 'What is the relationship between conscientiousness and (a) blood pressure and (b) heart rate in response to a laboratory-based stress task?' was addressed. Results revealed no main effects of conscientiousness group on blood pressure or heart rate. Likewise, no interactive effects between time, conscientiousness and blood pressure or heart rate were found. As a result, this study did not find evidence to support a relationship between conscientiousness and (a) blood pressure or (b) heart rate. As a result, these findings were not in keeping with the findings of Heponiemi (2004) who demonstrated greater heart rate activity in individuals high in impulsiveness, or for the findings of Allen et al. (2009) who demonstrated that individuals high in impulsiveness had lower heart rate activity.

Next, the research question 'What is the relationship between stress appraisals and blood pressure in individuals high and low in conscientious in response to a laboratory-based stress task, when conscientiousness is assessed in terms of total

conscientiousness and the lower order facets of conscientiousness?' was addressed. Findings indicated that for the low conscientiousness group, no significant associations between appraisals and blood pressure reactivity or recovery were observed. However, for the high conscientiousness group, primary appraisals were found to be significantly associated with systolic blood pressure reactivity and recovery. Similarly, hierarchical multiple regression analyses revealed that primary appraisals were able to predict blood pressure reactivity and recovery in those high in conscientiousness, yet they were unable to predict in those low in conscientiousness. When conscientiousness was examined at facet level, the same pattern of results held, with appraisals able to predict reactivity and recovery in most instances for those high in each facet of conscientiousness, yet rarely for those low in facets of conscientiousness. These results suggest that within those high in conscientiousness, high primary appraisals, i.e., a greater feeling of threat and stress, were associated with a lesser increase in systolic blood pressure as well as with a faster recovery to baseline systolic blood pressure.

These findings are particularly important given that heightened physiological reactivity and/or delayed recovery are processes through which stress is known to influences health (Steptoe, 2007; Chida & Steptoe, 2009); with the possibility that increased activation of the autonomic nervous system may lead to increased wear and tear on the immune, cardiovascular and endocrine systems (McEwen, 1998), resulting in inefficient activation of the systems and/or hormonal imbalance, which in turn may influence physical health over the life course. Therefore, as the results of this current study have indicated, that under particular circumstances, individuals high in conscientiousness are able to reduce the length of time that their blood pressure is elevated in response to stress. Moreover, this may mean that these individuals are less likely to experience the deleterious effects of the stress process on their physical health.

The current results also support the findings of Merecz et al. (1999) who were able to demonstrate that conscientiousness moderated the cardiovascular response to occupational stress when assessed in terms of systolic blood pressure. Consistent with the current findings, this effect was observable when blood pressure was measured in terms of systolic blood pressure activity but not when measured in terms of diastolic blood pressure activity. One explanation for this observation may be that systolic blood pressure is more reactive than diastolic blood pressure, with results from Smeets et al. (2012) also displaying greater systolic blood pressure reactivity in response to the MAST procedure when compared to diastolic blood pressure. Importantly, there is evidence to suggest that firstly, when compared to elevations in diastolic blood pressure, elevations

in systolic blood pressure are better predictors of health outcomes, such as cardiovascular disease (Kannel et al., 1969; Banegas et al., 2002; Wright et al., 2014). Secondly, evidence has demonstrated that systolic blood pressure is more difficult to control in comparison to diastolic blood pressure (Hyman & Pavlik, 2001), and lastly that elevations in systolic pressure can increase left ventricular load and the occurrence of left ventricular hypertrophy (Madhaven et al., 1994). Therefore, it seems that elevations of systolic blood pressure have the potential to convey a greater negative effect on physical health when compared to changes in diastolic blood pressure.

Although initial analyses did not indicate clear differences in primary appraisal scores between conscientiousness groups, the results suggested that when individuals high in conscientiousness anticipated higher levels of stress, threat and demands, they were able to deal with the situation more effectively and prevent the anticipated stress from triggering greater systolic blood pressure reactivity. In addition to this, they were able to overcome the experienced stress more quickly. These findings support the idea that in some situations, perceiving higher levels of stress can be beneficial to the individual (Yerkes & Dodson, 1908). It is possible that by recognising the extent of the demands placed upon them, an individual may be better equipped to overcome the stressor.

Moreover, there is evidence to support this idea, with the first known evidence emerging over a century ago (Yerkes & Dodson, 1908). Within this research, an 'inverted U' shaped model of arousal and performance termed 'eustress' was postulated. This suggests that low to moderate stress exposure may have the capacity to enhance performance and resilience. Subsequent research has suggested that the adaptive purpose of physiological stress may be to alert the stress system and assist it to prepare for potential challenges (Dhabhar, 2008), and it is only when this this system becomes dysregulated via prolonged activation, i.e., chronic stress that it is no longer adaptive. Therefore, in regards to the current study, it seems plausible that, in high conscientiousness individuals, anticipating greater levels of stress may have enabled the stress system to prepare for potential changes, which in turn allowed the system to better cope with the laboratory stressor. Relatedly, research by Aschbacher et al. (2013) which investigated the effects of acute and chronic stress on psychobiological resilience highlighted the importance of the psychobiological processes that occur in anticipation of an upcoming stressor. Within this study, greater perceived stress and anticipatory threat were associated with significantly reduced levels of oxidative damage, a health outcome related to stress. Therefore, the findings of the current study can be

interpreted to be in line with those of Aschbacher et al. (2013), in that greater perceived stress and threat, i.e., primary appraisal, were associated with reduced physiological outcomes associated with stress.

Unexpectedly, the opposite effect was not observed in those low in conscientiousness. One possible explanation for this may be that the participants who were low in conscientiousness may not have engaged with the task to the same extent as those high in conscientiousness; which is conceivable given the nature of low conscientiousness. As a result, they may have disregarded the importance of completing the task to the best of their ability. What is evident here is that the relationship between conscientiousness, appraisals and physiological responses is a complex one that requires further investigation. Future research should include the employment of more sophisticated measures of stress reactivity, for example through the measurement of cortisol (e.g., Kirschbaum et al., 1993; Nater et al., 2006). In addition, it would desirable for future research to assess the relationship between conscientiousness, appraisals and behavioural responses in order to assess whether the conscientiousness-appraisal relationship influences alternative pathways to better health.

When discussing the possible pathways through which stress and conscientiousness may interact, it is important to consider that the type of stressor and context of the stressor may influence a person's reactivity to stress. Alongside this, it is also important to consider that in particular circumstances, individuals who are high in conscientiousness may respond more negatively to stress than those low in conscientiousness. Whether an individual perceives high or low levels of control over the given situation may be particularly important here (although as previously discussed there is conflicting evidence as to the importance of stressor appraisal). For example, when a highly conscientious individual perceives full control over a situation, they are likely to be able to employ a coping strategy that allows them to overcome the situation and diminish the stressor. However, on the contrary, when an individual high in conscientiousness experiences low levels of control over the situation, conscientiousness may interfere with flexible problem solving (Hoga & Ones, 1997). If an individual's plan to overcome the situation is not effective, and the individual is not able to resolve the stressful situation, the highly conscientious individual may experience increased reactivity to the stressor.

Another point that is noteworthy was the problematic recruitment experienced within this sample, with individuals low in conscientiousness proved extremely difficult to recruit. This may mean that the low conscientious participants included in the current

study may have scores higher than a truly representative sample. With this in mind, it may be that individuals who are even lower in conscientiousness than the participants included in this study experience an even greater physiological response and delayed recovery to stress, meaning that they are more at risk to the damaging effects of stress than health than is currently understood.

We acknowledge that there are limitations associated with using laboratory based stress induction procedures. To begin with, the stress experienced as a result of the MAST procedure may not be representative of stressors experienced in daily life. As previously discussed, the nature of the task at hand may be responsible for differences observed in the SAM and HPA axes activation. It is possible that conscientiousness may be more or less protective with regards to different types of stress, e.g., social vs physical, and so this should be assessed in future investigations. Next, the level of stress induced may not be reflective of daily stressors experienced in daily life, and as a result may have led to an increased or decreased stress response. Finally, one other limitation that should be noted is that subjective stress ratings can be significantly higher when measured throughout the task when compared to those obtained after the stressor (Hellhammer and Schubert, 2012), and as a result the appraisal scores calculated may not be truly reflective of actual real-time stress appraisals.

In conclusion, primary appraisals were found to be associated with systolic blood pressure reactivity and recovery in individuals high in conscientiousness, but not within those low in conscientiousness. Therefore, this study found evidence to suggest that there is a differential effect of reactivity to stress that is associated with level of conscientiousness. Results indicated that the primary appraisals of stressful situations seem to be particularly important for being able to deal with anticipated stress physiologically, and well as the indication that anticipating greater levels of stress may in fact be beneficial in some circumstances. This finding has added to the current body of literature as to the best of our knowledge, no study has previously demonstrated this relationship. However, the relationship between conscientiousness, stress reactivity and health remains a particularly complex one, which requires further investigation in order to elucidate the precise pathways through which anticipated stress can reduce systolic blood pressure reactivity and recovery. Furthermore, research is required to assess whether this phenomenon is extended when more sophisticated physiological indicators are employed, and when different types of stress are experienced.

Chapter 5

5 STUDY 4: THE EFFECTS OF AN EATING MANAGEMENT SUPPORT TOOL AND CONSCIENTIOUSNESS ON THE DAILY HASSLE-UNHEALTHY SNACKING ASSOCIATION: A DAILY DIARY STUDY

5.1 Introduction

Within this chapter, the association between stress and unhealthy between-meal unhealthy snacking is assessed in individuals with high and low levels of conscientiousness. In line with the framework proposed by Bolger and Zuckerman (1995), exposure to stress is examined in terms of number of daily hassles experienced. Additionally, the appraisals of daily hassles and daily affect are discussed in relation to conscientiousness group and unhealthy between-meal snacking. Furthermore, the effectiveness of an implementation intention based intervention targeting unhealthy between-meal snacking is assessed for the conscientiousness groups.

5.1.1 Stress and health behaviours

As outlined earlier, it is widely accepted that stress can impact health directly, via autonomic and neuroendocrine activity. More recent evidence has suggested that stress may also impact health indirectly, via its influence on health behaviours (e.g., O'Connor et al., 2009). The experience of stress may contribute to the progression of diseases such as cardiovascular disease and cancers via both changes in eating behaviours and/or the maintenance of unhealthy eating behaviours. Recent studies, conducted in both laboratory and naturalistic settings, have suggested that high levels of stress are associated with increased between meal snacking (Conner et al., 1999; Cartwright et al., 2003; O'Connor & O'Connor, 2004), specifically high fat and high sugar snacks (O'Connor et el., 2008), increased saturated fat consumption (Wardle et al., 2000) as well as with binge eating (Crowther et al., 2001); whilst negatively associated with overall calorie intake (Wardle et al., 2000), main meal and vegetable consumption (O'Connor et al., 2008). These findings are particularly alarming given that a recent survey of 10,000 people revealed that 44% of those sampled reported suffering from

stress (Bupa, 2013), alongside the widely accepted premise that a healthy and balanced diet is essential for maintaining good physical health.

5.1.2 Conscientiousness and the stress-health behaviour association

In addition to this growing body of work, recent research has highlighted that the personality trait of conscientiousness may be a protective factor for the stress-health behaviour relationship. It has been proposed that individuals may experience a different quantity of stressors dependent upon their level of conscientiousness - with the proposition that individuals high in conscientious may encounter fewer stressors - which will have a direct impact upon health via less activation of basic biological systems. Further to this, it has been proposed that the experience of a fewer number of stressors may lead to fewer fluctuations in eating behaviour, which may have an indirect impact upon health (McEwen, 1998; Vollrath; 2000; Lee-Baggeley et al. 2005; O'Connor et al., 2009).

In a study conducted by O'Connor et al. (2009) results showed that individuals low in conscientiousness reported a lower number of daily stressors in comparison to individuals high in conscientiousness. One explanation for this finding may be that individuals high in conscientiousness may be more likely to plan in advance and demonstrate higher levels of organisation; meaning that they can avoid daily stressors that result from a lack of preparedness. This notion has been iterated by Wayne et al. (2004). In regards to the finding that conscientiousness was associated with lower levels of conflict; these authors noted that careful planning, effective organisation, and efficient time management may allow highly conscientious individuals to accomplish more in the time available to them, which should consequently reduce time pressures, and also possibly reduce stress and strain, which in turn reduces conflict.

Within the O'Connor et al. (2009) study the authors simultaneously investigated the direct effects of conscientiousness on health behaviours and daily stressors and its moderating effects on the stress-health behaviour relationship. Results indicated that not only was conscientiousness associated with more beneficial health behaviours, but that conscientiousness moderated the effects of daily hassles on vegetable consumption, with individuals low in conscientiousness consuming fewer portions of vegetables on more stressful days. Therefore, there is support for the principle that conscientiousness may influence health directly through changes in health behaviours and indirectly via its influence on the stress-health behaviour relationship.

5.1.3 Stress appraisals

Relatedly, alternative research has demonstrated the importance of stress appraisals within the conscientiousness-stress relationship. In a study investigating whether conscientiousness predicted the cognitive appraisals of daily hassles, findings suggested for the first time that conscientiousness, and the lower order conscientiousness facets of order and industriousness, were related to primary appraisals of daily hassles, whilst the lower order facet of responsibility was associated with secondary appraisals of daily hassles. Further analyses revealed that order and industriousness were able to predict the perception of having a greater stake in daily hassles whilst responsibility was able to predict a perceived ability to deal with daily hassles (Gartland et al., 2012). However, these findings were only in relation to a single daily hassle. In a second study utilising a more sophisticated daily diary design over a 14-day period, Gartland et al. (2013) investigated the effects of conscientiousness on daily hassles, appraisals and affect. Results indicated that conscientiousness moderated the relationship between stress appraisals and positive affect, whereby when individuals low in conscientiousness appraised hassles as stressful, this negatively impacted positive affect. As a result, it was concluded that conscientiousness may exert some of its desirable influences on health by moderating the effects of daily stressors.

5.1.4 Affect

Affect can be described as the experience and feeling of emotions (Hogg et al., 2010) which can be assessed to provide a measure of emotional well-being (Mackinnon et al., 1999). A variety of studies have demonstrated that affect is related to a number of health indicators, such as hypertension, immune system functioning, biological functioning and mortality (Jonas & Lando, 2000; Kiecolt-Glaser et al., 2002; Wilson et al., 2003; De Gucht et al., 2004; Pressman & Cohen, 2005; Steptoe et al., 2009). Furthermore, there is also evidence suggesting that mood is related to immune system functioning (Cohen & Herbert, 1996), as well as the occurrence of future physical symptoms (Steptoe & Wardle, 2005). What is more, affect has been found to be associated with physiological measures such as blood pressure and cortisol (Steptoe & Wardle, 2005), which are central measures of stress reactivity. Therefore, affect may be an important factor in the conscientiousness-stress-health relationship. Within this current study, the association between daily affect and stress will be assessed in individuals with high and low levels of conscientiousness.

5.1.5 Daily diary methods

One problem with previous research examining the relations between conscientiousness, stress and health has been that many studies have been overly reliant upon cross-sectional methodologies that have not allowed for the examination of within-person fluctuations. These approaches have overlooked the importance of within-person changes that have been highlighted by a number of studies (e.g., Sher, 2004; Fifield et al., 2004), which have particular relevance for the fields of stress and eating behaviour given that these are processes that are open to change over time (e.g., Kanner et al., 1981). Of the 194 studies included in the influential Bogg and Roberts (2004) meta-analysis, only ten of the studies employed longitudinal designs. The authors noted the difficulty of drawing inferences based upon such cross-sectional studies and suggested that future investigations ought to utilise daily diary approaches to "provide a more definitive test of the relationship between conscientiousness and health-related behaviors" (p. 912). The use of open-ended online diaries enables participants to conveniently record numerous and frequent day-to-day occurrences over multiple time points, and thus allow for these important within-person fluctuations to be examined. In addition, these techniques are not constrained to laboratory based settings, allowing the completion of studies in naturalistic settings; they reduce recall bias as the researcher is able to determine the specifics of when participants can complete their entries - which increases control over the problematic methodological issue of 'back-filling'. Lastly, and most importantly, they allow for participants to be used as their own controls. What is also noteworthy is that the utilisation of daily diaries allows for the use of the sophisticated analytical technique of multi-level modelling.

5.1.6 Interventions

The principal motive for enhancing the current body of literature regarding the established relationship between conscientiousness, stress and health is to enable the design of successful interventions. More recent research has therefore endeavoured to: (a) Identify cognitive and/or behavioural variables as targets for interventions, and (b) Identify vulnerable populations who require assistance in regards to their health (e.g., O'Connor et al., 2008; O'Connor et al., 2009; Gartland et al., 2012; Gartland et al., 2013; O'Connor et al., 2014; Wilson et al., 2015). Varied intervention techniques have been tested with a view to targeting either stress management or maladaptive health

behaviours. However, only one intervention to date has been successful in the identification of stressful situations that trigger unfavourable changes in health behaviour responses and then helped to facilitate a more adaptive behavioural response (O'Connor et al., 2015). Within this theory-based intervention, implementation intentions were utilised to develop an innovative low-cost, easily administered and timely stress management support tool (SMS). Furthermore, this research received commendation for its utilisation of the progressive daily diary methods and multi-level analysis, alongside its practical application to behaviour change (Hagger, 2015). Importantly, the development of the stress management support tool was largely informed by the success of implementation intention based interventions (e.g., Adriaanse et al., 2009, 2011) alongside the success of the Volitional Help Sheet (VHS) tool (Armitage 2008; Armitage & Arden, 2010).

5.1.7 Implementation intentions

Implementation intentions are self-regulatory strategies that are used to help individuals translate their behavioural intentions into actual behaviour. That is to say, they aim to bridge what is commonly referred to as the 'intention-behaviour gap'. Although behavioural intention to engage with beneficial behaviours may be high, individuals often have difficulty in translating their good intentions into actual behaviour (Gollwitzer, 1999). This is particularly the case for complex behaviours, such as smoking, healthy eating and physical activity (e.g., D'Onofrio et al., 2002; Milne et al., 2002; Armitage et al., 2004). Furthermore, research has suggested that simply having goal intentions is not sufficient to translate intentions into behaviour (Webb & Sheeran, 2006). The fundamental difference between goal intentions and implementation intentions is that a goal intention only specifies an end result, whereas an implementation intention specifies 'where', 'when' and 'how' a goal will be reached. Forming an implementation intention requires a person to specify a place, a time and an action that will enable their intention to be translated into behaviour. For example, 'If I am at work, and it is 11am, I will eat a healthy snack'. As a result, a critical situation (the where and when) is linked to an appropriate response (the how). The formation of the implementation intention allows an appropriate time for action to become more salient. Furthermore, according to Gollwitzer (1999) the situation should become automatically associated with the behaviour, and thus the individual should be required to give little

thought to what an appropriate behavioural response should be, when presented with the given situation.

A number of health behaviours have been the targets of implementation intention interventions. For example, implementation intentions have been utilised to promote physical activity (Bélanger-Gravel et al., 2013); lower alcohol consumption (Hagger et al., 2012); cancer screening (Neter et al., 2014); a healthy diet (Adriaanse et al., 2011); breast self-examination (Prestwich et al., 2005); testicular self-examination (Steadman & Quine, 2004) and to increase vitamin C intake (Sheeran & Orbell, 1999). However, for most of these behaviours, the aim of the implementation intention intervention is for the person to initiate a new behaviour. However, for the domain of eating behaviour, the challenge may be more complex in that it is often not only the case that a new behaviour is required to be practiced, but an undesired response is often required to be supressed (e.g., to eat a healthy snack instead of an unhealthy snack). Therefore, this 'replacement' of existing behaviours with new alternative behaviours may present an additional challenge for implementation intention based interventions, as it has been demonstrated that replacing existing behaviours is somewhat more difficult than initiating new behaviours, particularly when the existing behaviour is habitual (Webb & Sheeran, 2006). With this in mind, it has been argued that more research is required to investigate the use of implementation intentions to change existing health behaviours (Gollwitzer & Sheeran, 2006; Adriaanse et al., 2009), rather than to simply learn additional behaviours. Notably, only a small number of studies have assessed the effectiveness of implementation intentions for replacing existing eating behaviours with new eating behaviours (e.g., Verplanken & Faes, 1999; Armitage, 2004).

Nevertheless, a meta-analysis of twenty-three studies (Adriaanse et al., 2011) demonstrated that the utilisation of implementation intention interventions were successful in promoting healthy eating (Cohen's *d = .51)* as well as discouraging unhealthy eating (Cohen's *d = .29)*, yet the use of implementation intentions seemed to be more effective for promoting healthy eating. Other research from Adriaanse et al. (2009) investigated the use of implementation intentions to modify eating behaviour. Within this research, the authors drew distinctions between situational and motivational cues for unhealthy snacking. Situational cues were classified as places, activities or company, for example, being at work, studying, watching television or being with friends. Alternatively, motivational cues were classified as perceived reasons for eating

unhealthy snacks, for example, feeling bored, feeling hungry or to be social. Interestingly, results showed that only implementation intentions that specified motivational cues (e.g., to be social) and not situational cues (e.g., watching television) were effective in reducing between meal snacks. This finding is particularly important as it not only highlights that there are in fact different types of cues, but also the importance of internal feelings and subjective states. In comparison to the use of traditional situational cues, these subjective states are rarely included in the formation of implementation intentions (Adriaanse et al., 2009). However, within the Adriaanse et al. (2009) study, participants were required to select their cue from a list of pre-defined cues. Although an additional study permitted participants to select a cue that was personally relevant to them, these too were determined from a pre-defined list. Given the vast number of triggers for unhealthy between-meal snacking, and individual differences in eating behaviour, it may have been possible for participants to generate cues that were even more personally relevant to them via them employment of a 'self-generating' method.

5.1.8 The Volitional Help Sheet

Based upon Gollwitzer's (1993) concept of implementation intentions, and Prochaska and DiClemente's transtheoretical model (1983), the Volitional Help Sheet (VHS) has provided a successful tool to deliver implementation intention based interventions. The VHS provides participants with a choice of critical situations and appropriate responses which they link together to form an implementation intention (Armitage, 2008). The physical drawing of a link between cues and responses enables the participant to visualise the implementation intention formed. The VHS has been applied to a number of health behaviours, and has yielded significant changes in behaviour. For example, Armitage (2008) demonstrated that significantly more people quit smoking whilst using the Volitional Help Sheet (19%) compared to those in an active control group (2%). Additional research from Armitage (2009) replicated this finding in relation to physical activity, and more recently these findings have been demonstrated for reducing binge drinking (Arden & Armitage, 2012). Yet to date, the VHS has not been employed to modify eating behaviour. However, informed by the VHS, and similar in design, the SMS tool developed by O'Connor et al. (2014) required participants to self-generate stressful situations in which they experienced negative emotions (critical cues)

and self-generate healthy snacks that they could eat in response to these situations (appropriate response). As stress induced changes in eating behaviour can be seen an attempt to regulate the negative emotions caused by the experience of stress (Hagger, 2015), it was deemed that any situation where a person experienced stress could be regarded as a motivational cue. Participants within the experimental condition linked the situations and responses to form the 'if-then' plan, whereas participants in the control condition did not. Results indicated that the intervention was effective in that daily hassles were associated with unhealthy snacking in the control condition, but not within the experimental condition. Although the authors were successful in designing an effective intervention tool to reduce stress-induced changes in between meal snacking, they did not consider conscientiousness as an influencing factor on the stress-snacking relationship, and to date, no known study has done so.

The effectiveness of implementation intention based interventions for individuals with varying levels of conscientiousness has been assessed. For example, in a study examining the efficacy of an implementation intervention for class attendance, conscientiousness was found to moderate the effectiveness of the intervention, with the intervention having a larger impact on individuals with low or moderate levels of conscientiousness than those who were high in conscientiousness (Webb et al., 2007). Similarly, research investigating self-initiated implementation intentions, impulsivity (a lower order facet linked to conscientiousness) and snacking behaviour demonstrated that impulsivity moderated the effect of the self-initiated implementation intention on snack consumption, with snacking highest in those low in impulsivity (Churchill & Jessop, 2010). Therefore, the use of implementation intentions appears to be most effective in individuals who have low or moderate levels of conscientiousness, in comparison to those who are high in conscientiousness. One possible explanation for these findings is that individuals high in conscientiousness may already be performing the desired behaviour (i.e., there was a ceiling effect) or similarly they may have already formed their own 'if-then' plans subconsciously. Indeed, there is support for this view that forming implementation intentions are of little value if the task is a simple one, or when self-regulation is not an obstacle (Gollwitzer & Brandstätter, 1997; Brandstätter et al., 2001; Dewitte et al., 2003; Webb & Sheeran, 2003). Relatedly, a commentary from Hagger (2015) on the research of O'Connor et al. (2014) highlighted the importance of self-control (a lower order facet of conscientiousness) in the context of overcoming automatic and non-conscious responses. Here it was suggested that in the context of

stress-induced eating, overcoming a learned behavioural response would require substantial self-control resources. Consequently, it was suggested that the capacity of implementation intentions to override existing behavioural responses would be of great assistance to individuals with low self-control resources, or whose resources have been depleted. Therefore, it seems probable that self-control, and thus conscientiousness, may be implicated in the effectiveness of implementation intention interventions targeting the stress-unhealthy eating relationship.

In summary, the aim of this study was to examine the effectiveness of an eating management support (EMS) tool for reducing unhealthy snacking behaviour in individuals high and low in conscientiousness. In this current study, participants were permitted to generate any situation in which they ate unhealthy snacks, to enable further investigation of the types of situations in which unhealthy snacks are consumed, as well as to be as personally relevant to the participants as possible. Specifically, the following hypotheses were tested:

i. There will be a positive association between daily hassles (number of hassles and hassle intensity) and unhealthy snacking, and this association will be moderated by conscientiousness, with the association greater for individuals low in conscientiousness compared to individuals high in conscientiousness.
ii. The positive association between daily hassles (number of hassles and hassle intensity) and unhealthy snacks will be moderated by condition, with a greater positive association for those in the active control condition compared to those in the experimental condition.
iii. Effects of condition on the daily hassle-unhealthy snacking behaviour relationship will be significantly different for high and low conscientious individuals.
iv. There will be a main effect of conscientiousness on appraisals of daily hassles and affect. Appraisals and affect will be associated with unhealthy snack consumption.
v. The types of situations generated within the EMS tool will differ between individuals high and low in conscientiousness, with those individuals low in conscientiousness generating more situational cues than those individuals high in conscientiousness.

5.2 Method

5.2.1 Participants

Please see Figure 5.1 and chapter four for details regarding participant recruitment procedures. The final sample consisted of 96 participants (84.4% female), with an average age of 27 years (range = 18-61 years) and an average BMI of 22.16 (range = 17.40 – 33.64). The sample were largely of Caucasian ethnicity (87.5%) with the remaining ethnicities (12.5%) including Chinese, Indian, Pakistani, Afro-Caribbean and mixed ethnicities. Sixty-six of the participants were either in education or unemployed, with the remaining thirty either employed or retired. 3.1% of the sample had an education level of GCSE or equivalent, 55.2% had obtained A-level qualifications or equivalent, 25% had obtained an undergraduate degree or equivalent and 15.6% had received a postgraduate qualification.

5.2.2 Design

A randomised controlled design was utilised which had two between-persons factors and four repeated measures factors. Between-persons factor one had two levels: active control and experimental, and factor two had two levels: high conscientiousness and low conscientiousness. Repeated measures were daily hassles, between-meal snacking, daily affect and hassle appraisal. An online daily diary questionnaire design was employed over 14 consecutive days. The intervention was delivered at day 0, and diary entries began the following day (day 1). An interval-contingent method was employed which entailed participants completing the daily diary at the end of each day and did not allow the diary to be 'back-filled'. Participants received a daily email reminder to complete the diary which contained the link to the online diary, which they were instructed they were able to complete between the hours of 5pm and 2am. Participants were informed that all entries were date and time stamped.

In total 1128 days of data were collected. Complete daily data was missing for 155 days because participants either failed to complete the daily entry or because they were unable to complete the diary within the time window specified. Following the procedure outlined by O'Connor et al. (2009), days within the diary that contained complete missing data were removed. In addition, days that contained other missing data were included in the analysis, by replacing such missing data with column means. In total, 973 days of data were included in the analysis.

The study received ethical approval from the Institute of Psychological Sciences, University of Leeds Ethics Committee (Ref: 14-0016). Participants were compensated with a £15 Love2shop voucher for their time.

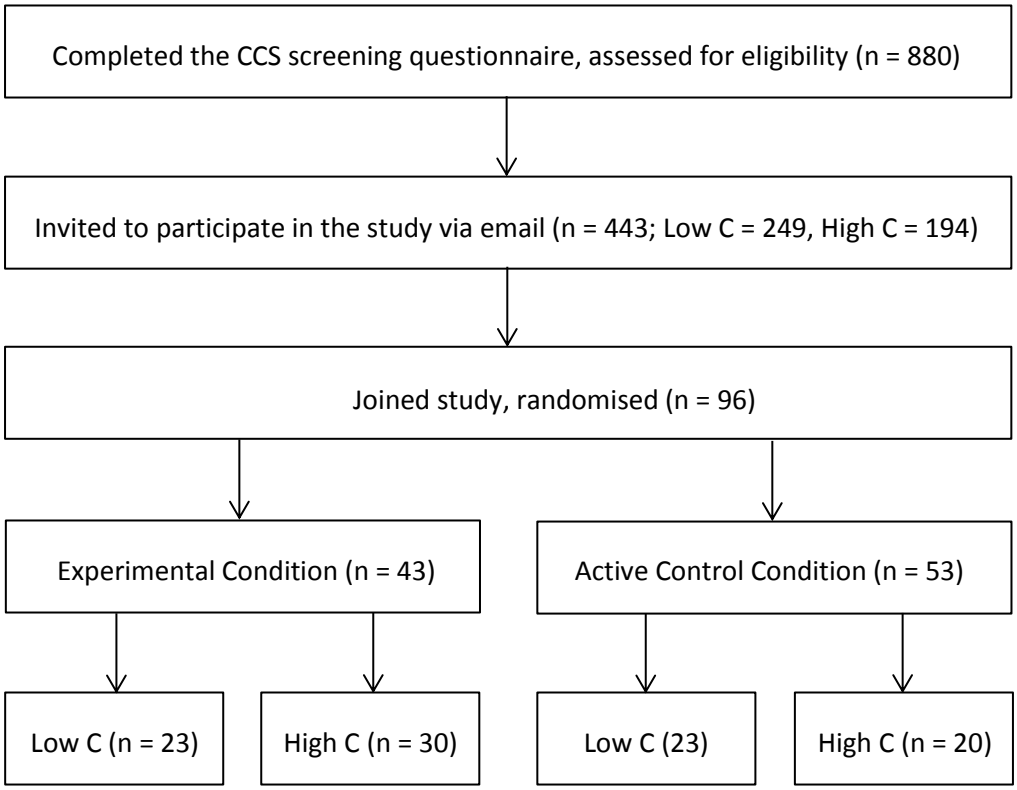

Figure 5.1. Flow diagram of participant recruitment.

5.2.3 Measures

5.2.3.1 Chernyshenko Conscientiousness Scales

Please see chapter three for details.

5.2.3.2 Eating Management Support Tool (EMS tool)

The EMS tool was a modified version of the SMS tool developed by O'Connor et al. (2014). The EMS tool was delivered in a pen and paper format. At the beginning of the task sheet, the following information was presented to both conditions: 'It is well established that when you are in certain situations, or experience particular feelings, you're more likely to eat high fat and sugar snacks between meals (e.g., to eat chocolate, crisps, cakes) and are less likely to eat fruit and vegetables. People who do not maintain a balanced diet, including eating a low fat diet and five portions of fruit and vegetables a day are likely to be at increased risk of developing heart disease and cancer as they get older. Therefore, we want you to PLAN how you will eat more healthy snacks when you are in these situations, or are subject to these feelings. What could these situations or feelings be? Although these will be different for each person, some of the most popular reasons people eat high fat and sugar snacks between meals are because they are stressed, because they are with friends, family, classmates or are alone, because they are chatting, watching television, studying or relaxing, or are hungry, feeling bored, socialising or because they are eating for enjoyment.'

The task instructions read as follows: 'STEP 1: In the box below (left hand column), please briefly describe UP TO FIVE situations in which you usually eat unhealthy snacks (such as chocolate, crisps, cakes). STEP 2: For EACH of these situations, please choose a healthy snack alternative you could eat. Remember to pick a snack that you really like and that would be usually available in each particular situation. Once chosen please enter it in the right hand column.'

Participants allocated to the experimental group were then presented with a further instruction which read 'STEP 3: Research has shown that these plans work best when you picture the specific situation in your mind and LINK each situation with your healthy snack choice. Therefore, please i) DRAW a line linking each 'situation' and 'healthy snack choice'; ii) THINK ABOUT yourself acting out each of your plans to eat healthier when you are in these situations.'

Participants in both conditions were provided with a table consisting of two columns and five rows. Following STEP 1 instructions, which were identical for both conditions, participants were required to self-generate critical situations in which they usually ate unhealthy snacks and write these in column one. Next, following STEP 2 instructions, which were identical for both conditions, participants were required to self-generate healthy snack alternatives and to write these in the spaces provided in column two. Participants in the active control condition had now completed the process. Participants allocated to the experimental condition were now required to follow STEP 3 instructions; in which they were asked to draw a line linking the critical situations to appropriate responses. Participants were then asked to think about themselves acting out these plans. The key difference between the conditions was therefore the linking of critical situations with appropriate responses compared to those in the control condition simply listed critical situations and responses. Therefore, the experimental condition adhered to Gollwitzer's (1993) theory of implementation intentions as links between critical situations and appropriate responses were made.

5.2.3.3 EMS Situation Type

The situational cues generated within the EMS tool were categorised in line with findings from Adriaanse et al. (2009). Cues were coded as 'Situational' in nature, i.e., 'when' or 'where' type situations or 'Motivational', i.e., 'why' situations. Next, a cue ratio was calculated in order to assess the number of situational cues generated in relation to the number of motivational cues generated. The cue ratio was calculated by subtracting the number of motivational cues generated from the number of situational cues generated. As a result, a positive cue ratio score represented a greater number of situational than motivational cues reported, whilst a negative score represented a greater number of motivational than situational cues reported.

5.2.3.4 Daily Diary Measures

5.2.3.4.1 Daily hassles

Participants were asked to list the daily hassles they experienced during the course of the day. Daily hassles were defined as: 'Events, thoughts or situations which, when they occur, produce negative feelings such as annoyance, irritation, worry or frustration, and/or make you subjectively aware that your goals and plans will be more

difficult or impossible to achieve as a result' (Delongis et al., 1982; Conner et al., 1999). Participants were asked to provide a description of each of the daily hassles that they experienced throughout the day as well as the time that they experienced the hassle. Examples of hassles were provided, such as a physical injury to you or a loved one, missing a bus and being late for an appointment. Participants were then asked to rate the hassle on a scale of intensity from 1 (not at all intense) to 5 (very intense). Intensity was defined as 'how severe/extreme your feelings were while you were experiencing the hassle'. A total of 1469 daily hassles were recorded, with an average of 1.5 hassles reported per participant per day.

5.2.3.4.2 Appraisals

Participants were then requested to appraise each hassle listed. Participants were informed that 'Appraisal is a process which allows an individual to evaluate whether a particular stressful encounter is relevant to his or her well-being, in what ways, and how they might deal with the situation (Lazarus & Folkman, 1984)'. The following items were delivered: 'How threatening did you find the daily hassle to be?', 'How demanding did you think the daily hassle was?', 'How stressful did you find the daily hassle to be?', 'To what extent did you think you would need to exert yourself to deal with the daily hassle?', 'How much effort (mental of physical) did you think the situation required you to expend?', (Five items; Cronbach's α = .90) 'Before the daily hassle was resolved, how well did you think you could manage the demands imposed on you by the daily hassle?', 'How able were you to cope with the daily hassle?', 'Before the daily hassle was resolved, how well did you think you performed or would perform in dealing with it?', 'I turned to work or other substitute activities to take my mind off things', 'I took additional action to try to get rid of the problem', 'I tried to come up with a strategy about what to do' and 'I gave up the attempt to get what I want'. (Seven items; Cronbach's α = .84). The response scale ranged from 1 to 7, with 1 indicating 'Not at all' and 7 indicating 'To a very large extent'.

5.2.3.4.3 Affect

Participants were asked to complete a measure of daily affect, in which they simply reported to what extent they had experienced the emotions/feelings listed, throughout the course of the day. Items included five positive emotions 'Inspired', 'Excited', 'Determined', 'Alert', and 'Enthusiastic' (Cronbach's α = .81) and five negative

emotions 'Afraid', 'Upset', 'Nervous', 'Scared', and 'Distressed' (Cronbach's α = .87) Participants were asked to select the response 'Very slightly or not at all', 'A little', 'Moderately', 'Quite a bit' or 'Extremely' for each emotion/feeling. The positive and negative items were averaged to create an overall positive affect and an overall negative affect score.

5.2.3.4.4 Between-meal snacking

Participants were asked to list each food that they had eaten between meals on that day, and the time at which they ate them (e.g. fruit, chocolate, crisps, nuts, cakes). Each between meal snack recorded was coded as low or high in terms of total fat, saturated fat and sugar. Using NHS guidelines (www.nhs.uk/livewell/goodfood) parameters for low and high were devised for each macronutrient type per 100grams. For total fat, low fat = 3 grams or less, high fat = 17.5 grams and above. For saturated fat, low = 1.5 grams or less, high = 5 grams or more. For sugar, low = 5 grams or less high = 22.5 grams or above. Each food was coded using McCance and Widdowson's 'The composition of Foods' which contains nutrient composition data based on information from The Food Standards Agencies UK Nutrient Databank. The total number of snacks recorded was 2079, with an average of 2.14 snacks reported per person per day.

Next, to measure perceived snacking, the following items were delivered 'To what extent have you eaten healthy snacks today? (e.g., apple, banana, dried fruit)' and 'To what extent have you eaten unhealthy snacks today? (e.g., chocolate, crisps, cakes)'. Items were scored on a 7 point scale from 'Not at all' (1) to 'Very much' (7).

5.2.3.4.5 Unhealthy Snacking

Unhealthy snacking was measured in four different ways. Firstly, unhealthy snacking was measured in terms of high total fat snacks, high saturated fat snacks and high sugar fat snacks. For each of these measures, the total number of each type of snack consumed per person per day was computed. Secondly, unhealthy snacking was measured in terms of perceived unhealthy snacking by utilising the score generated in response to the item and 'To what extent have you eaten unhealthy snacks today? (e.g., chocolate, crisps, cakes)' (as above).

5.2.4 Procedure

Following completion of the online CCS screening measure, participants were invited to visit the Stress and Reactivity laboratory at the university department via email invitation. Firstly, participants were asked to complete the measure of behavioural intention to consume fruits and vegetables and unhealthy snacks over the following 14 days alongside the measure of motivation. Participants were then randomly allocated to the control group or experimental group. To ensure the experimenter was blind to the condition being allocated, the control and experimental task sheets were placed in identical envelopes and sealed. These envelopes were then sorted into a random order. The task sheets were identical looking with the exception that the experimental task sheet had one extra paragraph at the end of the instructions section. The experimenter delivered the task to the participant who was sat in a private testing cubicle, in a controlled laboratory setting, and informed the participant that instructions to complete the task were included within the envelope. The researcher then left the room to allow the participant to complete the planning intervention alone. Participants were instructed to complete the online diary for the following 14 days, starting the following day, and were instructed to complete their diary entry as closely before going to bed as possible.

5.2.5 Statistical Analysis

The statistical technique of multi-level modelling (Raudenbush et al., 2004) was utilised to analyse the data. A two-level hierarchical structure comprised of level 1 – within person factors (e.g., daily hassles, snacking behaviour), and level 2 – between person factors (e.g., conscientiousness group, condition). To begin with, level 1 within person effects were modelled. Statistically significant effects were then followed up with a level 2 between person models to examine the effects of level 2 variables on the level 1 relationships. Statistically significant cross-level interactions were de-composed by re-examining the model in terms of group (for example, high conscientiousness group vs. low conscientiousness group). In most instances, the following equation represented the cross-level models (Poisson):

$$\text{Outcome variable} = \beta_{00} + \beta_{01}(\text{level 2 variable}) + \beta_{10}(\text{level 1 variable}) + \beta_{11}(\text{level 2 variable*level 1 variable}) + r_{0+}r_{1}(\text{level 1 variable}) + \varepsilon$$

The β_{00} (intercept) coefficient represents the log of the event rate and indicates whether this value is significantly different from zero. The β_{01} coefficient indicates the extent to which there is a main effect on the intercept, and whether this is significant. β_{10} suggests the size and direction of the association between the variables, and whether this association is significant. β_{11} indicates any moderating effects (i.e., whether there is a cross level interaction) on the relationship seen in β_{10}. r_0 is the error term associated with the intercept, r_1 is the error term associated with the slope and ε is the error term.

The models examining unhealthy snacks in terms of number of high fat snacks, number of high saturated fat snacks and number of high sugar snacks were analysed using a Possion link function (Hilbe, 2007). As the outcome variable was a count variable, this model was deemed appropriate. When the level 1 sampling model is Poisson, a log function is employed. As a result, an event rate (number of snacks consumed) of one is given a log of zero, meaning that the log is negative. Similarly, when an even rate is greater than one, the log is positive. Therefore, a negative intercept suggests that on average, less than one snack was consumed per day, an intercept of zero suggests that on average one snack was consumed per day, and a positive intercept suggests that on average more than one snack was consumed per day. In addition, as the data utilised here were longitudinal in nature, and we were interested in group and individuals level processes, the unit-specific models with robust standard errors were reported (Hu et al., 1998; Bauer & Streba, 2011). Conversely, the models examining perceived snacking were 'Normal'. As these variables were continuous variables, and not count variables, a Poisson link function was not necessary. Here, the intercept values are illustrative of given scores.

5.3 Results

5.3.1 Descriptive statistics and preliminary analysis

Descriptive statistics for all level 1 (within-person) and level 2 (between-person) study variables can be found in Table 5.1. Data are presented by conscientiousness group (high and low) and condition (experimental and active control), alongside total sample data.

Level 1 variable data revealed that within the total sample, an average of 1.5 daily hassles were experienced per day, with an average intensity of 2.52. Individuals

low in conscientiousness reported experiencing a slightly higher number of hassles, but of a slightly lesser intensity when compared to those high in conscientiousness. Across the whole sample, an average of 2.14 snacks were consumed per person per day. Individuals high in conscientiousness, alongside individuals in the experimental condition, reported consuming a higher number of snacks than the total sample average, however individuals high in conscientiousness reported consuming a lower number of high fat, high saturated fat and high sugar snacks than the sample average. Similarly, the same pattern was observed in individuals in the control condition. Individuals high in conscientiousness perceived themselves as consuming less unhealthy snacks and more healthy snacks compared to those low in conscientiousness, whereas individuals in the experimental condition perceived themselves to consume more unhealthy and healthy snacks compared to those in the control condition.

Primary appraisal scores were higher in those low in conscientiousness when compared to their counterparts, indicating greater feelings of stress and threat than for those scoring high in conscientiousness. Likewise, secondary appraisal scores were lower in those low in conscientiousness, suggesting a greater perception of inability to cope with daily hassles. Positive affect was found to be higher in participants high in conscientiousness, whilst negative affect was high in those low in conscientiousness.

Table 5.1. Descriptive statistics for level 1 (within-person) and level 2 (between-person) study variables across a 14 day period.

	Low Conscientiousness (*N* = 46)	High Conscientiousness (*N* = 50)	Active Control Condition (*N* = 53)	Experimental Condition (*N* = 43)	Total sample (*N* = 96
Level 1 variables					
Total hassles	1.59 (1.32)	1.45 (1.14)	1.52 (1.23)	1.50 (1.21)	1.51 (1.22)
Hassles intensity	2.47 (1.47)	2.56 (1.66)	2.54 (1.60)	2.49 (1.57)	2.52 (1.58)
Total snacks	2.11 (1.42)	2.16 (1.46)	2.11 (1.52)	2.17 (1.35)	2.14 (1.45)
High fat snacks	.99 (.96)	.86 (.88)	.86 (.91)	.97 (.92)	.91 (.91)
High saturated fat snacks	.89 (.95)	.80 (.85)	.75 (.85)	.92 (.93)	.84 (.89)
High sugar Snacks	.92 (.96)	.77 (.82)	.75 (.85)	.93 (.92)	.83 (.89)
Perceived unhealthy snacking	3.74 (1.94)	3.12 (1.82)	3.23 (1.85)	3.55 (1.94)	3.37 (189)
Perceived healthy snacking	3.65 (1.98)	3.58 (2.06)	3.69 (2.04)	3.51 (2.01)	3.61 (2.03)
Primary appraisals	3.67 (1.29)	3.54 (1.31)	3.67 (1.28)	3.50 (1.32)	3.60 (1.30)
Secondary appraisals	3.78 (2.07)	3.95 (2.28)	3.94 (2.22)	3.81 (2.17)	3.88 (2.20)
Positive affect	2.41 (.86)	2.73 (.92)	2.57 (.89)	2.64 (.94)	2.60 (.91)
Negative affect	1.99 (.96)	1.72 (.85)	1.83 (.88)	1.84 (.95)	1.83 (.91)
Level 2 variables					
Age	23.25 (7.71)	29.93 (12.75)	27.99 (12.49)	22.29 (9.07)	26.68 (11.07)
Male/Female (% female)	10/36 (78.3%)	5/45 (90.0%)	7/46 (86.8%)	8/35 (81.4%)	15/81 (84.4%)
BMI	21.76 (2.92)	22.52 (3.55)	21.94 (3.31)	22.43 (3.22)	22.16 (3.24)
Links (in the exp. condition)	4.74 (1.36)	4.75 (.56)	__	4.3 (1.74)	__
Situations	4.56 (.72)	4.40 (1.24)	4.31 (1.13)	4.67 (.64)	4.45 (.97)
Responses	4.53 (.76)	4.38 (1.12)	4.29 (1.14)	4.65 (.65)	4.43 (.98)

For the EMS tool, the mean number of situations in which participants usually ate snacks was 4.45 (experimental condition = 4.3, active control condition = 4.67), and the mean number of healthy snack alternatives (responses) was 4.43 (experimental condition = 4.29, active control condition = 4.65). *t*-test analysis revealed that the number of snacking situations generated did not vary across conditions (*t* (89) = -1.64, p = *ns),* and nor did the number of responses generated (*t* (89) = -1.59, p = *ns)*. The average number of links drawn (in the experimental condition) was 4.3, indicating that not all participants linked each situation to an appropriate response. The most frequent situations when snacks were eaten were watching television, feeling bored and when with friends. The most frequent healthy snack responses reported were fruit followed by nuts, with the most popular fruits specified as apples, grapes and bananas.

Multivariate analysis of variance (MANOVA) revealed no significant main effects of conscientiousness or condition on gender or BMI, and thus confirmed baseline equivalence for the groups for these measures. However, analysis revealed a significant main effect of conscientiousness on age, *F* (94) = 9.80, *p* <.01, therefore age was controlled for in all subsequent analyses.

Univariate analysis of variance (ANOVA) revealed a significant main effect of conscientiousness on the number of daily diary entries completed (*F* (94) = 10.14, *p* < .01). Individuals low in conscientious completed an average number of 8.98 diary days, whilst individuals high in conscientiousness completed an average of 11.2 diary days, of a potential 14 diary days. Further analyses revealed no significant main effect of condition on number of daily diary entries.

As can be seen in Figure 1., the number of individuals categorised as high or low in conscientiousness differed between conditions (experimental condition: low C = 23, high C = 20; active control condition: low C = 23, high C = 30). All subsequent analyses were computed with equal numbers of low and high C individuals per condition, i.e., the experimental condition contained 20 low C and 20 high C, whilst the active control condition contained 23 low C and 23 high C. These participants were selected via the order that they participated in the study, with those last to participate in the study excluded. However, comparison of analyses revealed that results were substantively the same. Therefore, all participants were retained in the analysis (n = 96) for completeness.

The following results test hypotheses 1, 2 and 3. Unhealthy snacks are examined in terms of high fat snacks, high saturated fat snacks, high sugar snacks and perceived unhealthy. Daily hassles are first assessed by number of daily hassles, followed by intensity of daily hassles. For convenience, the main study hypotheses are restated below:

Hypothesis (i) There will be a positive association between daily hassles (number of hassles and hassle intensity) and unhealthy snacking, and this association will be moderated by conscientiousness, with the association greater for individuals low in conscientiousness compared to individuals high in conscientiousness.

Hypothesis (ii) The positive association between daily hassles (number of hassles and hassle intensity) and unhealthy snacks will be moderated by condition, with a greater positive association for those in the active control condition compared to those in the experimental condition.

Hypothesis (iii) Effects of condition on the daily hassle-unhealthy snacking behaviour relationship will be significantly different for high and low conscientious individuals.

5.3.2 High fat snacks (total fat)

The results of each model examining the effects of daily hassles on high fat snack consumption are presented in Table 5.2 and Table 5.3. The initial level 1 model (Table 5.2) indicated that total number of daily hassles were significantly positively associated with number of high fat snacks consumed ($\beta = .09$, $p < .01$). When conscientiousness was included in the model, the association (slopes) between daily hassles and high fat snacks remained significant ($\beta_{10)}$. Results did not indicate an effect of conscientiousness on high fat snack consumption ($\beta_{01),}$ however a cross-level interaction ($\beta_{11)}$ for snacking was observed, indicating that conscientiousness moderated the daily hassle–high fat snack consumption relationship ($\beta = - .13$, $p < .01$).

When condition was included in the model (Table 5.2) the association between daily hassles and high fat snacks became non-significant and no effect of condition on high fat snack consumption was observed. Examination of the cross-level interaction revealed a trend towards statistical significance ($\beta = .10$, $p = .08$), suggesting that condition also moderated the daily hassle–high fat snack consumption.

Next, a multiplicative interactive term (Conscientiousness*Condition) was entered into the model. The result indicated that conscientiousness and condition did not interact to affect the daily hassles-high fat snacks relationship.

Further examination of the interactions revealed that when individuals high and low in conscientiousness were assessed independently (Table 5.3), findings indicated that daily hassles were significantly positively associated with high fat snacks in those low in conscientiousness (β = .28, $p < .01$), yet not in those high in conscientiousness (β = .04, p = ns), such that individuals low in conscientious consumed more high fat snacks on more stressful days. Surprisingly, results suggested that daily hassles were significantly positively associated with high fat snacks for individuals in the experimental condition, yet were not significantly associated in individuals in the active control condition, meaning that individuals in the experimental condition consumed more high fat snacks on more stressful days. These interactions were also decomposed using simple slopes procedures for multi-level modelling as recommended by Preacher et al. (2006). Figure 5.2 presents the moderating effects of conscientiousness on the daily hassle-high fat snack relationship, whilst Figure 5.3 presents the moderating effects of condition on the daily hassle-high fat snack relationship.

Table 5.2. Effects of conscientiousness and condition on the daily hassle–high fat snack consumption relationship

HLM effect	Symbol	Coefficient	SE	*P* value
Intercept	β_{00}	-.32	.06	<.01
Level 1 slope				
Daily hassles-high fat snacks	β_{10}	.09	.04	<.01
Intercept	β_{00}	-.49	.28	ns
Conscientiousness	β_{01}	.09	.17	ns
Age	β_{02}	.00	.00	ns
Level 1 slope				
Daily hassles-high fat snacks	β_{10}	.35	.08	<.01
Conscientiousness* Daily hassles-high fat snacks	β_{11}	-.13	.06	<.01
Age* Daily hassles-high fat snacks	β_{12}	.00	.00	ns
Intercept	β_{00}	-.35	.41	ns
Condition	β_{01}	-.05	.17	ns
Age	β_{02}	.00	.00	ns
Level 1 slope				
Daily hassles-high fat snacks	β_{10}	.05	.13	ns
Condition* Daily hassles-high fat snacks	β_{11}	.10	.05	$p = .07$
Age* Daily hassles-high fat snacks	β_{12}	.00	.00	ns
Intercept	β_{00}	-.89	.83	ns
Conscientiousness	β_{01}	.37	.53	Ns
Condition	β_{02}	.28	.51	Ns
Conscientiousness*Condition	β_{03}	-.21	.35	Ns
Age	β_{04}	.00	.00	Ns
Level 1 slope				
Daily hassles-high fat snacks	β_{10}	.24	.24	Ns
Conscientiousness* Daily hassles-high fat snacks	β_{11}	-.15	.18	Ns
Condition* Daily hassles-high fat snacks	β_{12}	.05	.14	Ns
Conscientiousness *Condition* Daily hassles-high fat snacks	β_{13}	.02	.11	Ns
Age* Daily hassles-high fat snacks	β_{14}	.00	.00	Ns

Table 5.3. Effects of conscientiousness and condition on the daily hassle–high fat snack consumption relationship, in low vs. high conscientiousness, and active control vs. experimental condition.

HLM effect	Symbol	Coefficient	SE	*P* value
High Conscientiousness				
Intercept	β_{00}	-.30	.35	Ns
Age	β_{01}	.00	.00	Ns
Level 1 slope				
Daily hassles-high fat snacks	β_{10}	.04	.14	Ns
Age* Daily hassles-high fat snacks	β_{11}	.00	.00	Ns
Low Conscientiousness				
Intercept	β_{00}	-.42	.24	Ns
Age	β_{01}	.00	.00	ns
Level 1 slope				
Daily hassles-high fat snacks	β_{10}	.28	.07	<.01
Age* Daily hassles-high fat snacks	β_{11}	.00	.00	ns
Active Control Condition				
Intercept	β_{00}	-.38	.29	ns
Age	β_{01}	.00	.00	ns
Level 1 slope				
Daily hassles-high fat snacks	β_{10}	.15	.11	ns
Age* Daily hassles-high fat snacks	β_{11}	.00	.00	ns
Experimental Condition				
Intercept	β_{00}	-.46	.40	ns
Age	β_{01}	.00	.00	ns
Level 1 slope				
Daily hassles-high fat snacks	β_{10}	.24	.10	<.05
Age* Daily hassles-high fat snacks	β_{11}	.00	.00	ns

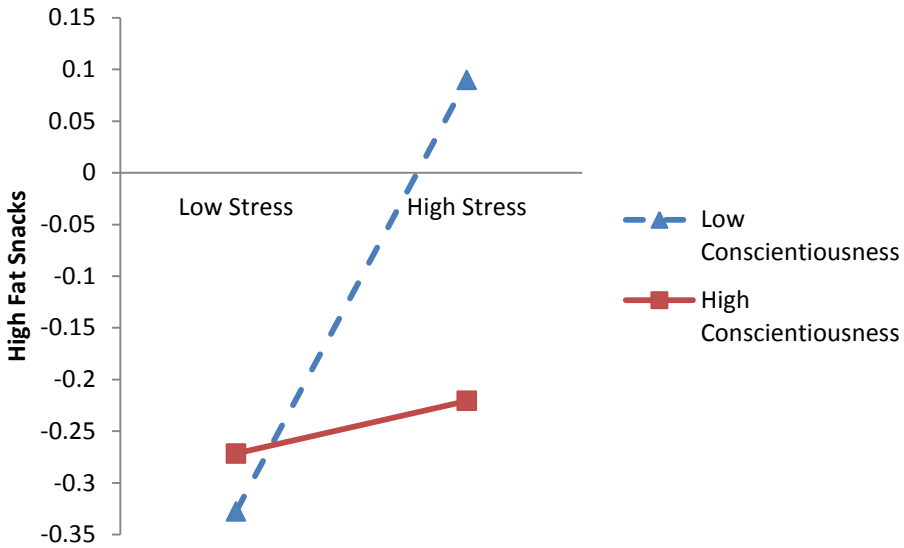

Figure 5.2. Moderating effects of conscientiousness on the daily hassle – high fat snack consumption relationship.

Note: Please note that because the sampling method is Poisson, when an event rate is less than one the log is negative. Therefore, the negative intercepts reflect an average of less than one snack per day.

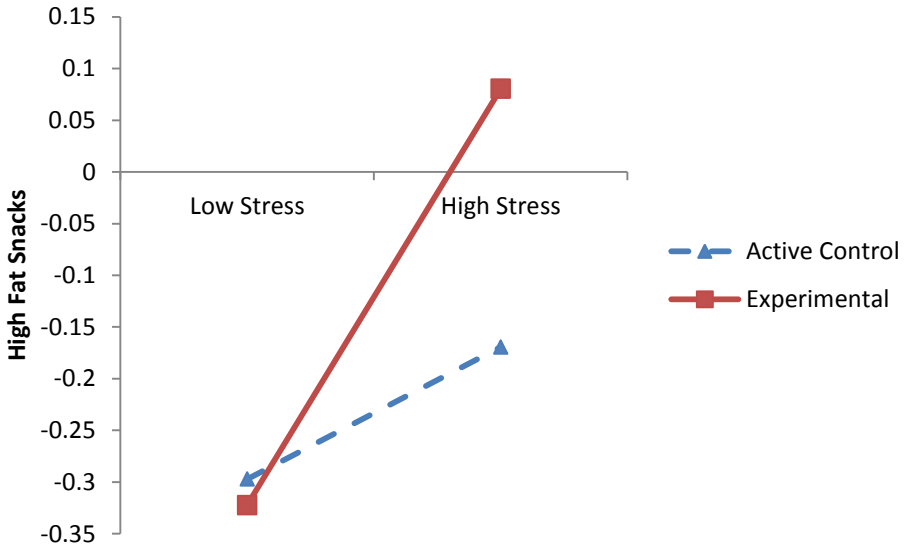

Figure 5.3. Moderating effects of condition on the daily hassle – high fat snack consumption relationship.

5.3.3 High Saturated Fat Snacks

The results of each model examining the effects of daily hassles on high saturated fat snack consumption are presented in Table 5.4 and Table 5.5. The initial level 1 model (Table 5.4) indicated that total number of daily hassles were significantly positively associated with number of high saturated fat snacks consumed (β = .11, p < .01). When conscientiousness was included in the model, the association between daily hassles and high saturated fat snacks remained significant. There was no effect of conscientiousness on high saturated fat snack consumption, yet a cross-level interaction was observed, indicating that conscientiousness moderated the daily hassle – high fat snack consumption relationship (β = - .15, p < .05).

When condition was included in the model (Table 5.4) the association between daily hassles and high saturated fat snacks became non-significant and no effect of condition on high saturated fat snack consumption was observed. The cross-level interaction did not reach a level of statistical significance, however a marginal effect was observed (β = - .11, p = .08).

Subsequently, the multiplicative interactive term (Conscientiousness*Condition) was entered into the model. Result suggested that effects of conscientiousness and condition on the daily hassles-high saturated fat snacks relationship were not interactive.

In depth examination of the effects of conscientiousness on the daily hassle–high saturated fat snack consumption relationship revealed that when individuals high and low in conscientiousness were assessed separately (Table 5.5), results indicated that daily hassles were significantly positively associated with high saturated fat snacks in those low in conscientiousness (β = .34, p < .01), yet not in those high in conscientiousness (β = .07, p = ns). Further investigation of the effects of condition on the daily hassle–high saturated fat snack consumption relationship revealed that daily hassles were significantly positively associated with high saturated fat snacks for individuals in the control condition (β = .22, p < .05), yet were only marginally related for those individuals in the experimental condition (β = .24, p = .06). These interactions were also supported by simple slopes analysis. Figure 4 presents the moderating effects of conscientiousness on the daily-hassle-high saturated fat snack relationship. Figure 5.5 presents the moderating effects of condition on the daily-hassle-high saturated fat snack relationship.

Table 5.4. Effects of conscientiousness and condition on the daily hassle–high saturated fat snack consumption relationship

HLM effect	Symbol	Coefficient	SE	*P* value
Intercept	β_{00}	-.43	.09	<.01
Level 1 slope				
Daily hassles-high saturated fat snacks	β_{10}	.11	.03	<.01
Intercept	β_{00}	-.75	.29	<.01
Conscientiousness	β_{01}	.13	.18	ns
Age	β_{02}	.00	.00	ns
Level 1 slope				
Daily hassles-high saturated fat snacks	β_{10}	.41	.09	<.01
Conscientiousness* Daily hassles-high saturated fat snacks	β_{11}	-.15	.07	<.01
Age* Daily hassles-high saturated fat snacks	β_{12}	.00	.00	ns
Intercept	β_{00}	-.59	.40	ns
Condition	β_{01}	-.03	.18	ns
Age	β_{02}	.00	.00	ns
Level 1 slope				
Daily hassles-high saturated fat snacks	β_{10}	.08	.14	ns
Condition* Daily hassles-high saturated fat snacks	β_{11}	.11	.06	$p = .08$
Age* Daily hassles-high saturated fat snacks	β_{12}	.00	.00	ns
Intercept	β_{00}	-1.31	.83	ns
Conscientiousness	β_{01}	.50	.54	ns
Condition	β_{02}	.38	.52	ns
Conscientiousness*Condition	β_{03}	-.25	.36	ns
Age	β_{04}	.00	.00	ns
Level 1 slope				
Daily hassles-high saturated fat snacks	β_{10}	.36	.24	ns
Conscientiousness* Daily hassles-high saturated fat snacks	β_{11}	-.22	.18	ns
Condition* Daily hassles-high saturated fat snacks	β_{12}	.02	.15	ns
Conscientiousness *Condition* Daily hassles-high saturated fat snacks	β_{13}	.05	.12	ns
Age* Daily hassles-high saturated fat snacks	β_{14}	.00	.00	ns

Table 5.5. Effects of conscientiousness and condition on the daily hassle–high saturated fat snack consumption relationship, in low vs. high conscientiousness, and active control vs. experimental condition.

HLM effect	Symbol	Coefficient	SE	*P* value
High Conscientiousness				
Intercept	β_{00}	-.44	.35	ns
Age	β_{01}	.00	.00	ns
Level 1 slope				
Daily hassles-high saturated fat snacks	β_{10}	.07	.14	ns
Age* Daily hassles-high saturated fat snacks	β_{11}	.00	.00	ns
Low Conscientiousness				
Intercept	β_{00}	-.72	.28	ns
Age	β_{01}	.00	.00	ns
Level 1 slope				
Daily hassles-high saturated fat snacks	β_{10}	.34	.08	<.01
Age* Daily hassles-high saturated fat snacks	β_{11}	.00	.00	ns
Active Control Condition				
Intercept	β_{00}	-.69	.29	ns
Age	β_{01}	.00	.00	ns
Level 1 slope				
Daily hassles-high saturated fat snacks	β_{10}	.22	.10	<.05
Age* Daily hassles-high saturated fat snacks	β_{11}	.00	.00	ns
Experimental Condition				
Intercept	β_{00}	-.51	.41	ns
Age	β_{01}	.00	.00	ns
Level 1 slope				
Daily hassles-high saturated fat snacks	β_{10}	.24	.13	*P* = .06
Age* Daily hassles-high saturated fat snacks	β_{11}	.00	.00	ns

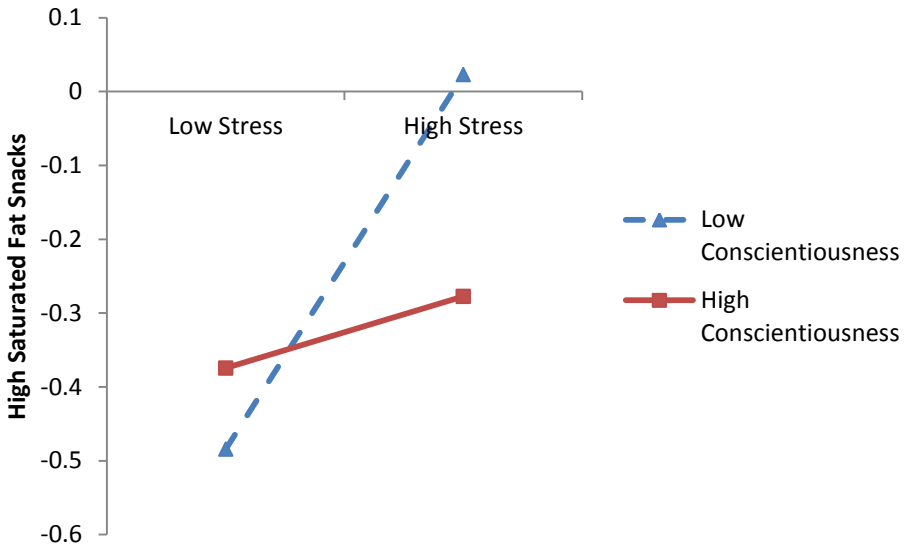

Figure 5.4. Moderating effects of conscientiousness on the daily hassle – high saturated fat snack consumption relationship.

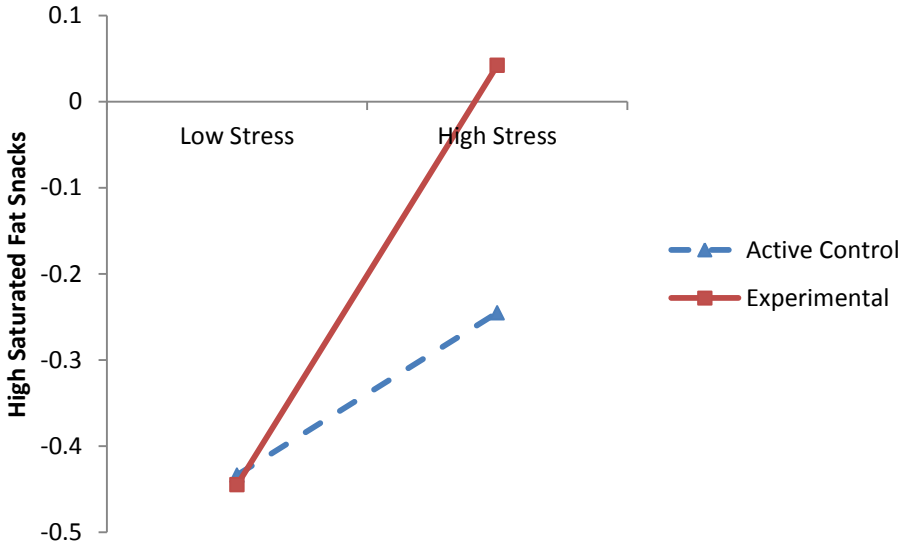

Figure 5.5. Moderating effects of condition on the daily hassle – high saturated fat snack consumption relationship.

5.3.4 High Sugar Snacks

The results of each model examining the effects of daily hassles on high sugar snack consumption are presented in Table 5.6. The initial level 1 model indicated that total number of daily hassles were significantly positively associated with number of high sugar snacks consumed (β = .11, $p < .01$). When conscientiousness was included in the model, the relationship between daily hassles and high sugar snacks remained significant, however there was no effect of conscientiousness on high sugar snack consumption. In addition, no cross-level interaction was observed, indicating that conscientiousness did not moderate the relationship between the daily hassle-high sugar snack consumption relationship. When condition was included in the model the association between daily hassles and high sugar snacks became non-significant. No effect of condition on high sugar snack consumption was observed and no cross-level interaction was found. Lastly, inclusion of the multiplicative interactive term (Conscientiousness*Condition) in the model revealed no interactive effects of conscientiousness and condition on the daily hassles-high sugar snacks relationship.

5.3.5 Perceived Unhealthy Snacking

The results of each model examining the effects of daily hassles on perceived unhealthy snacking are presented in Table 5.7. The initial level 1 model (Table 5.7) indicated that total number of daily hassles were significantly positively associated with perceived unhealthy snacking (β = .19, $p < .01$). When conscientiousness was included in the model, the relationship between daily hassles and perceived unhealthy snacking remained significant, however there was no effect of conscientiousness on perceived unhealthy snacking. Furthermore, no cross-level interaction was observed, suggesting that conscientiousness did not moderate the relationship between the daily hassles–perceived unhealthy snacking association. When condition was included in the model the association between daily hassles and perceived unhealthy snacking remained significant. However, there was no significant effect of condition on perceived unhealthy snacking and no cross-level interaction found. Again, inclusion of the multiplicative interactive term (Conscientiousness*Condition) in the model unveiled no interactive effects of conscientiousness and condition on the daily hassles-perceived unhealthy snacking relationship.

Table 5.6. Effects of conscientiousness and condition on the daily hassle–high sugar snack consumption relationship

HLM effect	Symbol	Coefficient	SE	*P* value
Intercept	β_{00}	-.45	.09	<.01
Level 1 slope				
Daily hassles-high sugar snacks	β_{10}	.11	.03	<.01
Intercept	β_{00}	-.49	.30	ns
Conscientiousness	β_{01}	-.05	.18	ns
Age	β_{02}	.00	.00	ns
Level 1 slope				
Daily hassles-high sugar snacks	β_{10}	.33	.09	<.01
Conscientiousness* Daily hassles-high sugar snacks	β_{11}	-.06	.06	ns
Age* Daily hassles-high sugar snacks	β_{12}	.00	.00	ns
Intercept	β_{00}	-.62	.38	ns
Condition	β_{01}	.06	.18	ns
Age	β_{02}	.00	.00	ns
Level 1 slope				
Daily hassles-high sugar snacks	β_{10}	.17	.11	ns
Condition* Daily hassles-high sugar snacks	β_{11}	.06	.05	ns
Age* Daily hassles-high sugar snacks	β_{12}	.00	.00	ns
Intercept	β_{00}	-.37	.83	ns
Conscientiousness	β_{01}	-.15	.54	ns
Condition	β_{02}	-.05	.52	ns
Conscientiousness*Condition	β_{03}	.07	.35	ns
Age	β_{04}	.00	.00	ns
Level 1 slope				
Daily hassles-high sugar snacks	β_{10}	.19	.23	ns
Conscientiousness* Daily hassles-high sugar snacks	β_{11}	-.04	.17	ns
Condition* Daily hassles-high sugar snacks	β_{12}	.08	.15	ns
Conscientiousness *Condition* Daily hassles-high sugar snacks	β_{13}	.02	.11	ns
Age* Daily hassles-high sugar snacks	β_{14}	.00	.00	ns

Table 5.7. Effects of conscientiousness and condition on the daily hassle–perceived unhealthy snacking relationship.

HLM effect	Symbol	Coefficient	SE	*P* value
Intercept	β_{00}	3.12	.15	<.01
Level 1 slope				
Daily hassles-perceived unhealthy snacking	β_{10}	.19	.06	<.01
Intercept	β_{00}	3.78	.50	<.01
Conscientiousness	β_{01}	-.15	.31	ns
Age	β_{02}	.02	.00	ns
Level 1 slope				
Daily hassles-perceived unhealthy snacking	β_{10}	.53	.20	<.01
Conscientiousness* Daily hassles-perceived unhealthy snacking	β_{11}	-.16	.12	ns
Age* Daily hassles-perceived unhealthy snacking	β_{12}	.00	.00	ns
Intercept	β_{00}	3.02	.58	<.01
Condition	β_{01}	.36	.31	ns
Age	β_{02}	-.02	.01	ns
Level 1 slope				
Daily hassles-perceived unhealthy snacking	β_{10}	.50	.21	<.01
Condition*Daily hassles-perceived unhealthy snacking	β_{11}	-.09	.12	ns
Age*Daily hassles-perceived unhealthy snacking	β_{12}	.00	.00	ns
Intercept	β_{00}	3.06	1.34	<.05
Conscientiousness	β_{01}	-.03	.88	ns
Condition	β_{02}	.43	.93	ns
Conscientiousness*Condition	β_{03}	-.06	.61	ns
Age	β_{04}	-.01	.01	ns
Level 1 slope				
Daily hassles-perceived unhealthy snacking	β_{10}	.57	.50	ns
Conscientiousness*Daily hassles-perceived unhealthy snacking	β_{11}	-.08	.33	ns
Condition*Daily hassles-perceived unhealthy snacking	β_{12}	.00	.36	ns
Conscientiousness *Condition*Daily hassles-perceived unhealthy snacking	β_{13}	-.07	.23	ns
Age* Daily hassles-high sugar snacks	β_{14}	.00	.00	ns

5.3.6 Perceived Healthy Snacking

Initial level 1 modelling revealed that daily hassles were not associated with perceived healthy snacking, and thus no further analysis was deemed necessary (β = -.02, *p* = ns).

Table 5.8. A summary of the level 1 relationship between number of daily hassles and snacking measures

HLM effect	Symbol	Coefficient	SE	*P* value
Intercept	β_{00}	-.32	.06	<.01
Level 1 slope				
Daily hassles-high fat snacks	β_{10}	.09	.04	<.01
Intercept	β_{00}	-.43	.09	<.01
Level 1 slope				
Daily hassles-high saturated fat snacks	β_{10}	.11	.03	<.01
Intercept	β_{00}	-.45	.09	<.01
Level 1 slope				
Daily hassles-high sugar snacks	β_{10}	.11	.03	<.01
Intercept	β_{00}	3.12	.15	<.01
Level 1 slope				
Daily hassles-perceived unhealthy snacking	β_{10}	.19	.06	<.01
Intercept	β_{00}	3.60	.19	<.01
Level 1 slope				
Daily hassles-perceived healthy snacking	β_{10}	-.02	.07	ns

5.3.7 Hassle intensity

Level 1 models indicated that intensity of daily hassles were not significantly associated with unhealthy snack consumption (Table 5.9), when assessed in terms of high fat snacks, high saturated fat snacks, high sugar snacks, or perceived unhealthy snacking. Therefore, it was not appropriate to examine the variables conscientiousness or condition as moderators.

Table 5.9. The hassle intensity-unhealthy snack consumption relationship

HLM effect	Symbol	Coefficient	SE	*P* value
Intercept	β_{00}	.86	.08	<.01
Level 1 slope				
Hassle intensity-high fat snacks	β_{10}	.02	.02	ns
Intercept	β_{00}	.78	.07	<.01
Level 1 slope				
Hassle intensity-high saturated fat snacks	β_{10}	.02	.02	ns
Intercept	β_{00}	.77	.08	<.01
Level 1 slope				
Hassle intensity-high sugar snacks	β_{10}	.02	.02	ns
Intercept	β_{00}	3.2	.17	<.01
Level 1 slope				
Hassle Intensity-perceived unhealthy snacks	β_{10}	.09	.05	ns

Hypothesis (iv). There will be a main effect of conscientiousness on appraisals of daily hassles and affect. Appraisals and affect will be associated with unhealthy snack consumption.

Initial level 1 modelling demonstrated that primary and secondary appraisals of daily hassles were not significantly associated with high fat snacks, high saturated fat snacks, high sugar snacks or perceived unhealthy snacking. Similarly, positive and negative affect were not significantly associated with high fat snacks, high saturated fat snacks, high sugar snacks or perceived unhealthy snacking.

Hypothesis (v). The types of situations generated within the EMS tool will differ between individuals high and low in conscientiousness, with those individuals low in conscientiousness generating more situational cues than those individuals high in conscientiousness.

The situations generated by participants within the EMS tool were further investigated in order to assess whether the type of situations reported differed between participants in the active control condition, as well as between individuals high and low in conscientiousness.

Descriptive statistics for number of situational cues, number of motivational cues and the cue ratio are presented in Table 5.10. Data revealed that the number of situational cues generated was greater in the experimental condition (mean = 3.16) compared to those in the active control condition (mean = 2.40). Conversely, the number of motivational cues was greater in the active control condition (mean = 1.83) when compared to those in the experimental condition (mean = 1.51). The cue ratio was greater for the experimental condition (1.65) compared to the active control condition (.57), suggesting that a greater proportion of the situations generated by individuals in the experimental condition were situational rather than motivational in nature. Lesser differences were observed when comparing individuals low in conscientiousness to individuals high in conscientiousness. Those scoring low in conscientiousness reported slightly more situational and motivational cues than those high in conscientiousness. The cue ratio indicated that the number of situational cues reported in relation to motivational cues, were slightly higher in those low in conscientiousness compared to those high in conscientiousness, but again, the difference was not as great as could be seen between the conditions.

Multivariate analysis of variance (MANOVA) revealed a significant main effect of Condition on the number of situational cues generated (F (96) = 7.69, $p < .01$), but no significant main effect on number of motivational cues given (F (96) = 1.33, p = ns). Importantly, analysis did reveal a significant effect of condition on the cue ratio (F (96) = 4.52, $p < .05$), such that a greater proportion of the situations generated by individuals in the experimental condition were situational rather than motivational in nature.

Multivariate analysis of variance (MANOVA) revealed no significant effect of Conscientiousness on the number of situational or motivational cues reported, or on the cue ratio, suggesting that these numbers did not differ significantly between participants who were low and high in conscientiousness.

Table 5.10. Means and standard deviation for situational cues, motivational cues and the cue ratio for individuals high and low in conscientious, and for individuals assigned to the active control and experimental conditions.

	Situational Cues	Motivational Cues	Cue Ratio
Low Conscientiousness	2.74 (1.47)	1.72 (1.39)	1.02 (2.69)
High Conscientiousness	2.74 (1.34)	1.66 (1.32)	1.08 (2.12)
Active Control Condition	2.40 (1.38)	1.83 (1.52)	.57 (2.61)
Experimental Condition	3.16 (1.31)	1.51 (1.10)	1.65 (2.33)
Total sample	2.74 (1.39)	1.69 (1.35)	1.05 (2.53)

5.4 Discussion

This study aimed to test a total of five hypotheses. Hypothesis one stated that 'there will be a positive association between daily hassles (number of hassles and hassle intensity) and unhealthy snacking, and this association will be moderated by conscientiousness, with the association greater for individuals low in conscientiousness compared to individuals high in conscientiousness'. Results indicated that there was a significant positive association between number of daily hassles and unhealthy snacks reported, when unhealthy snacks were examined in terms of number of high fat snacks, number of high saturated fat snacks, number of high sugar snacks and perceived unhealthy snacking. Furthermore, conscientiousness was found to moderate the relationship between daily hassles and unhealthy snacks when unhealthy snacks were examined in terms of high fat snacks and high saturated fat snacks. In these cases, the positive association between daily hassles and unhealthy snacking was found to be greater for individuals low in conscientiousness in comparison to individuals high in conscientiousness. Therefore, support was found for hypothesis 1 when daily hassles were assessed in terms of number of daily hassles. When daily hassles were assessed in terms of daily hassle intensity, results indicated that daily hassle intensity was not

significantly associated with unhealthy snacking. Therefore, quantity of daily hassles may be more important than intensity of hassles for subsequent unhealthy between-meal snacking.

As a result, further evidence has been provided to support the findings of O'Connor et al. (2008) who showed that daily hassles were positively associated with high fat and high sugar between-meal snacking. Likewise, these results were in line with the findings of O'Connor et al. (2014) where it was demonstrated that daily hassles were associated with unhealthy snacking but not healthy snacking. Consequently, this study provided evidence for the association between stress and unhealthy snacking, alongside support for the proposed mechanism that conscientiousness may influence health indirectly via its influence on the stress-health behaviour association. Moreover, this study highlights conscientiousness as an important factor for the stress-health behaviour association, a finding which has only been demonstrated in a limited number of studies.

Next, further analyses were conducted to test hypothesis two 'the positive association between daily hassles (number of hassles and hassle intensity) and unhealthy snacks will be moderated by condition, with a greater positive association for those in the active control condition compared to those in the experimental condition'. Results revealed that condition moderated the relationship between number of daily hassles and unhealthy between-meal snacking when snacking was examined in terms of high fat snacks and high saturated fat snacks, but only at a level that could be regarded as being marginally statistically significant. Unexpectedly, the association between daily hassles and unhealthy snacking was found to be somewhat greater for individuals who were assigned to the experimental condition, when compared to those individuals assigned to the active control condition, indicating that the intervention did not work as anticipated. As a result, some support was found for hypothesis two, in that condition did moderate the relationship to some extent, however not in the anticipated direction.

Subsequent analyses were conducted to test hypothesis three 'the effects of condition on the daily hassle-unhealthy snacking behaviour relationship will be significantly different for high and low conscientious individuals'. However, no support was found to support this hypothesis as results suggested that conscientiousness and condition did not significantly interact to moderate the daily hassle-unhealthy snacking relationship.

Hypothesis four 'there will be a main effect of conscientiousness on appraisals of daily hassles and affect. Appraisals and affect will be associated with unhealthy snack

consumption' was next assessed. Findings indicated that primary and secondary appraisals of daily hassles were not significantly associated with any of the between-meal snacking measures. Likewise, positive and negative affect were not significantly associated with any of the between-meal snacking measures. Therefore, no evidence was seen to support hypothesis four.

Lastly, the types of situations that were generated within the EMS tool were analysed in order to test hypothesis five 'the types of situations generated within the EMS tool will differ between individuals high and low in conscientiousness, with those individuals low in conscientiousness generating more situational cues than those individuals high in conscientiousness'. Results revealed no significant effect of conscientiousness on the number of situational or motivational cues reported or on the cue ratio, and as a result no support was found for hypothesis five. However, results revealed that there was a main effect of condition on the number of situational cues generated, as well as the cue ratio, suggesting that individuals in the experimental condition generated more situational cues than those in the active control condition, which may offer one possible explanation for the unexpected results seen within the experimental condition.

The individuals within the experimental condition did not show a lesser relationship between daily hassles and unhealthy snacks than those individuals within the active control condition, meaning that these findings were not consistent with the findings of O'Connor et al. (2014). There are a number of possible reasons which may explain the absence of the anticipated effect. Firstly, although the active control group did not link the situations in which they reported consuming unhealthy snacks with appropriate responses, their protocol did comprise of a number of components. For example, as with the participants allocated to the experimental condition, the control participants were required to list both situations and appropriate responses. It could well be the case that this process was more effective for reducing number of unhealthy snacks in response to daily hassles. It is plausible that this process may have permitted participants to have more flexibility in their responses when faced with a critical situation (a daily hassles), whereas the plans formed within the experimental condition may have been too rigid and not allowing for situational matters such as food availability and accessibility. It is therefore desirable for future research investigating the effectiveness of this tool to collect baseline data pre-intervention, in order to allow for the comparison of these two processes.

Relatedly, it is noteworthy that fruits were the most popular healthy snack alternative generated; as a number of previous studies have been unable to demonstrate the ability of implementation intentions to increase fruit consumption (Jackson et al., 2005; DeNooijer et al., 2006; DeVries et al., 2008). Therefore, there seem to be barriers for the utilisation of implementation intention interventions for increasing fruit consumption. Particular barriers, or factors that may be highly relevant to fruit consumption are as previously mentioned, availability and accessibility. There is an increasing amount of literature highlighting the importance of availability and accessibility for health related behaviours (e.g., VanEmpelen & Kok, 2008), and specifically in regards to fruit consumption, research has demonstrated that implementation intentions do not predict fruit consumption when preparatory actions are controlled for (Osch et al., 2010). Therefore, it may be the case that participants formed successful plans to consume alternative healthy snacks; but when the critical situation was presented the participants may not have been able to access the specified foods. This may be the case particularly for individuals low in conscientiousness, as research has shown that self-regulation in the form of preparedness and planning are particularly important for assisting fruit consumption (Osch et al., 2010), which are qualities known to be associated with high levels of conscientiousness (see the facet of Order, Green et al., 2015). Alternatively, individuals who were high in conscientiousness may have already been consuming numerous portions fruits on a daily basis, a notion which was supported in chapter 3, and so selecting these foods as appropriate responses may have been problematic in that the participant may have felt they were already consuming a large amount of fruit per day, and as a result did not replace their unhealthy snacks with fruits.

In addition, the stress management support tool employed by O'Connor et al. (2015) only permitted participants to generate stress related cues for unhealthy snacking, i.e., motivational cues. Within this current study, participants were permitted to generate any cue in which they ate unhealthy snacks, in order to capture as many triggers for unhealthy snacking as possible, for example, emotional eating (O'Connor et al., 2008), as well as to make the intervention as personally relevant as possible. As findings indicated that the number of situational and motivational cues significantly differed between the conditions, with individuals in the experimental condition generating a higher proportion of situational cues, it may be the case that the intervention is only effective in relation to motivational cues, which is plausible given

the findings of Adriaanse et al. (2009) that motivational cues were more effective than situational cues for reducing unhealthy snacks.

One other possible reason the differential effects may be that the intervention is not suitable for those individuals who are scoring particularly low or particularly high in conscientiousness. As O'Connor et al. (2015) employed a random sample of participants and did not recruit based upon personality characteristics, it may have been the case that the distinct groups captured in this research may have had an influential effect. It is possible that for individuals high in conscientiousness, the support tool was of little use as these individuals may have already been performing the desired behaviours, and thus there was a ceiling effect, which is conceivable given the known association between conscientiousness and unhealthy eating; and further supported by the findings of Webb et al. (2007) who demonstrated that an implementation intention based intervention was not effective in individuals who had high levels of conscientiousness.

It is also possible that individuals high in conscientiousness may have formed or may routinely form their own plans that may have interfered with those formed within the intervention. Similarly, the individuals who were low in conscientiousness may have not engaged with the task as directed, which is possible given the finding that they completed fewer diary entries; and thus this may have influenced the success of the intervention. Therefore, it would be valuable to replicate this study with individuals with moderate levels of conscientiousness in order to assess any personality related differences. Importantly, the finding that individuals low in conscientiousness had higher attrition rates is not only notable in terms of intervention engagement, but may also be important for recognising that within this current study there may be an under-estimation of the strength of the association between low conscientiousness, stress and unhealthy between-meal snacking. Furthermore, this finding has provided sought after data that is supportive of the association between lower levels of conscientiousness and greater attrition rates (Gartland et al., 2013). This is an important result given that it may have implications for future research employing longitudinal methods.

One further possible explanation and limitation of this study is that by chance, the conditions may have differed in terms of eating behaviour prior to the intervention. For example, the individuals in the experimental condition may have generally consumed a greater number of unhealthy snacks than those individuals in the active control condition, and this may provide an explanation as to why a greater number of unhealthy snacks were consumed by individuals within the experimental condition. This

also highlights the importance of collecting daily diary entries prior to the intervention in order to provide baseline measures.

It is acknowledged that the data were self-reported, and therefore may be subject to bias. Although employment of objective measurements of between-meal snacking are highly desirable, such methods are highly burdensome to the participant. Given the difficulties experienced in recruitment of low conscientious individuals, it was deemed that this method was not appropriate for this group of participants. Nevertheless, future research employing more representative samples would benefit from utilisation of more objective methods as more detail and higher levels of accuracy could be gained.

To summarise, number of daily hassles were found to be associated with unhealthy between-meal snacking, and this association was shown to be moderated by conscientiousness, with a greater association between daily hassles and unhealthy between-meal snacking in individuals low in conscientiousness when compared to individuals high in conscientiousness. Therefore, this study provided support for the role of conscientiousness for the stress-unhealthy eating relationship. A greater association between unhealthy between-meal snacking and daily hassles was found for the individuals within the experimental condition when compared to those within the active control condition, suggesting that the active control condition was more effective at reducing unhealthy snacking in response to stress. Notably, the type of cue for unhealthy between-meal snacking seems to be important for this intervention. Future interventions should continue to target individuals low in conscientiousness, as these individuals have been shown to be particularly vulnerable to the negative outcomes associated with unhealthy between-meal snacking.

Chapter 6

6 GENERAL DISCUSSION

6.1 Aims and overview of the thesis

The association between conscientiousness, health and longevity is well established (Kern & Friedman, 2008). However, the mechanisms through which conscientiousness is translated into better health are not well understood. Numerous studies have supported the finding that conscientiousness is positively associated with beneficial health behaviours and negatively associated with detrimental health behaviours (Bogg & Roberts, 2004); however it is recognised that health behaviours can only partially explain how conscientiousness can be translated into better health and greater life expectancy (Friedman, 1993). Alongside this, the relationship between conscientiousness and specific health behaviours are only well understood when conscientiousness is measured as a unified construct, and not when measured in terms of its lower order facets. Furthermore, what is even less well understood are the alternate mechanisms through which conscientiousness conveys its beneficial effect. As a result, the main aim of this thesis was to further understand the conscientiousness-health behaviour relationship and to further understand the alternate mechanisms through which conscientiousness conveys its beneficial effects on health.

Within this thesis this aim was addressed by: (a) studying the structure of conscientiousness at facet level in order to understand the relationships between specific facets and specific health behaviours (chapter 2 and chapter 3), (b) assessing the Theory of Planned Behaviour variable Behavioural Intention as a mediator of the conscientiousness-fruit and vegetable consumption relationship (chapter 2), (c) assessing health behaviours in terms of the current U.K. health behaviour guidelines (chapter 3) (d) examining stress as mechanism through which conscientiousness can impact health, specifically in terms of stress reactivity (chapter 4), (e) utilising a 14-day daily diary design to assess the relationship between stress, specifically in terms of stress exposure, and unhealthy between-meal snacking (chapter 5), (f) examining the effectiveness of a implementation intention based intervention to reduce unhealthy

snacking for individuals with different levels of conscientiousness (chapter 5), and (g) utilising participants with high and low levels of conscientiousness in order to compare associations.

A number of explanatory mechanisms were identified, such as behavioural intention and stress, with significant effects on health behaviours found. Therefore, these findings suggest that these mechanisms may contribute to the understanding of the conscientiousness-health-longevity relationship.

6.2 Summary of key findings

Throughout this thesis, a variety of methodologies and measures were employed, which have produced a number of important findings. Here, a summary of these findings are presented by chapter.

Chapter 2 described the first study conducted as part of this research, which utilised survey data of 2136 participants from the United States. Then main aim of this chapter was to assess whether conscientiousness and its facets (in particular, industriousness & traditionalism) were significantly associated with behavioural intentions to consume fruit and vegetables and self-reported fruit and vegetable consumption; as well as to test whether behavioural intention fully mediated the association between conscientiousness and self-reported fruit and vegetable consumption. Results suggested that conscientiousness and each of its facets were positively correlated with both behavioural intention to consume fruits and vegetables and self-reported fruit and vegetable consumption. Furthermore, as expected, findings confirmed that the effects of conscientiousness on self-reported behaviour are fully mediated by behavioural intention; when conscientiousness was conceptualised in terms of a unified construct, as well as in terms of the facets of responsibility, virtue, industriousness, and order. Results also indicated that behavioural intention accounted for around 20% of the variance in self-reported behaviour.

In addition, a secondary aim of this chapter was to elucidate which facets of conscientiousness were most strongly associated with fruit and vegetable consumption. Results revealed that the facets of Industriousness and Responsibility were most strongly associated with behavioural intentions to consume fruit and vegetables, whilst the facets of Order and Virtue were most strongly associated with self-reported fruit and vegetable consumption. These results were somewhat inconsistent with the findings of the Bogg and Roberts (2004) meta-analysis; however, different types of eating

behaviour were assessed within this meta-analysis to this study here. Therefore, no particular pattern between the lower order facets and specific health behaviours were identified.

As a result of these findings, it was concluded that low levels of conscientiousness were found to be associated with lower fruit and vegetable intentions, with lower fruit and vegetable intentions also associated with lower fruit and vegetable consumption.

Chapter 3 presented the second study of this thesis, which employed a cross-sectional survey design and included data from 879 participants within the United Kingdom. In order to build upon the finding of chapter 2, that individuals with higher levels of conscientiousness consumed more portions of fruit and vegetables, fruit and vegetable consumption was assessed in relation to the current U.K. behaviour guidelines. This allowed assessment of whether there were any differences in guideline adherence between individuals with high and low levels of conscientiousness, or whether individuals high in conscientiousness simply consumed more than their counterparts, as this was unclear within the body of literature available. Furthermore, an improved measure of fruit and vegetable consumption was employed, alongside measurements of the health behaviours smoking, physical activity and alcohol intake. Alongside this, the lower order structure of conscientiousness was explored via factor analysis.

The main aims of this chapter were firstly to explore the structure of conscientiousness in terms of its lower order facets, secondly to examine whether conscientiousness and its facets could predict alcohol intake, smoking, physical activity and fruit and vegetable consumption guideline adherence when examined as individual health behaviours as well as when they were combined to create an overall health index, and lastly to explore the extent to which the effects of conscientiousness on health behaviour guideline adherence differed in individuals with high and low levels of conscientiousness.

Results from the factor analysis revealed that the items employed to measure the facets of industriousness, order, virtue, traditionalism and self-control largely loaded into five distinguishable factors, and that each of these factors demonstrated good internal reliability. However, the lower order facet of responsibility did not factor well, with only three of ten items loading above the critical value of .40.

Next, results revealed that total conscientiousness and each of its facets were positively associated with adherence to the health behaviours smoking, fruit and vegetable consumption and alcohol intake but were not associated with physical activity. Correlation coefficients revealed that total conscientiousness was most strongly associated with alcohol intake, followed by smoking and fruit and vegetable consumption. In addition, total conscientiousness and each of its facets were also positively associated with the health behaviour adherence guideline index, with the facet of industriousness emerging as the pre-eminent predictor of the index. It was demonstrated that conscientiousness and each of its facets could predict the health behaviour guideline adherence index, after controlling for age, gender and education.

Lastly, results demonstrated that individuals with low levels of conscientiousness did not adhere to the health behaviour adherence guideline index to the same magnitude as individuals with high levels of conscientiousness. Importantly, findings suggested that almost twice as many individuals with high levels of conscientiousness met all four health behaviour guidelines in comparison to those with low levels of conscientiousness.

In conclusion, the findings of this study suggested that the items employed to measure the facets of industriousness, order, self-control, virtue and traditionalism are reliable and represent separate lower order facets of conscientiousness, whilst the items employed to measure the facet of responsibility are not reliable and should be revised. Moreover, it was concluded that conscientiousness is associated with health behaviour guideline adherence, and not merely greater levels of desirable health behaviours.

Chapter 4 outlined an experimental study in which psychological and physiological reactiveness to an acute stress eliciting protocol was measured. The purpose of this study was to assess whether stress was associated with conscientiousness, specifically in terms of reactivity to stress, as stress has been proposed as a mechanism through which conscientiousness may convey its beneficial effects on health. Within this study, 101 participants visited a laboratory setting to participate in the study. Measurements included appraisals, state anxiety, blood pressure reactivity and heart rate reactivity, both before and after the stress protocol was delivered. The main aims of this study were to understand what the relationship between conscientiousness and appraisals, state anxiety, blood pressure and heart rate is; as well as to understand if the primary or secondary appraisal of stress can influence

physiology in terms of blood pressure, and whether this differs in individuals with diverse levels of conscientiousness.

Unexpectedly, results suggested that conscientiousness and its facets were not significantly correlated to appraisals or state anxiety. Furthermore, no main effects of conscientiousness group on appraisals or state anxiety were observed, and no interactive effects between conscientiousness and appraisals or state anxiety were found, which was inconsistent with previous findings. In regard to the physiological measurements, results revealed no main effects of conscientiousness group on blood pressure or heart rate, and no interactive effects between conscientiousness and blood pressure or heart rate were found. Therefore, no straight forward relationships between conscientiousness and these variables appeared to be present.

However, results revealed that the relationship between conscientiousness and stress reactivity may be a particularly complex one. Findings indicated that for the high conscientiousness group, primary appraisals were significantly correlated with systolic blood pressure reactivity and recovery, yet were not associated in the low conscientious group. Similarly, results revealed that primary appraisals were able to predict blood pressure reactivity and recovery in the high conscientiousness group yet were unable to predict in the low conscientiousness group. These results suggest that within those high in conscientiousness, high primary appraisals, i.e., a great feeling of threat and stress, were associated with a lesser increase in systolic blood pressure as well as with a faster recovery to baseline systolic blood pressure. Granting that distinct differences between the groups were not clear to see in initial analyses, these findings do suggest that there are differences between the groups. Therefore, this study found evidence to suggest that there is a differential effect of reactivity to stress that is associated with level of conscientiousness. Although these differences do appear to be subtle and somewhat complex, the cumulative effect of these differences over time could be significant for health. In conclusion, this study highlighted the importance of the appraisal of a stressful situation for dealing with stress physiologically.

Chapter 5 discussed the last study conducted as part of this thesis. Within this study, a 14 day online daily diary was completed by 96 participants following participation in an implementation intention based intervention to reduce the daily-hassle unhealthy between-meal snacking relationship. This study aimed to (1) examine the relationship between number of daily hassles experienced and subsequent unhealthy between meal snacking in individuals with low and high levels of

conscientiousness, (2) assess the relationship between conscientiousness and stress when stress was examined in terms of stress exposure, (3) explore the association between appraisals of a daily hassle and unhealthy between-meal snacking, (4) explore the association between daily affect and unhealthy between-meal snacking (5) examine the effectiveness of an implementation intention based intervention targeting unhealthy between-meal snacking for individuals low and high in conscientiousness, lastly (6) explore the types of situations and responses generated within the intervention in relation to conscientiousness group and condition.

As hypothesised, results indicated that there was a significant positive association between number of daily hassles and unhealthy snacks reported. Furthermore, conscientiousness was found to moderate the relationship between daily hassles and unhealthy snacks, such that the positive association between daily hassles and unhealthy snacking was found to be greater for individuals low in conscientiousness in comparison to individuals high in conscientiousness, and thus highlighted conscientiousness as an important factor within this relationship. Next, results suggested that condition moderated the relationship between number of daily hassles and unhealthy between-meal snacking, but only at a level that could be regarded as being marginally statistically significant. Unexpectedly, the association between number of daily hassles and unhealthy snacking was found to be somewhat greater for individuals who were assigned to the experimental condition, when compared to those individuals assigned to the active control condition. Therefore, the intervention appeared to have some influence on the stress-snacking association, but in a way that was not anticipated. Further analysis revealed that conscientiousness and condition did not significantly interact to moderate the daily hassle-unhealthy snacking relationship.

In addition, results suggested that primary and secondary appraisals of daily hassles, as well as positive or negative daily affect, were not significantly associated with between-meal snacking measures. Interestingly, results did show that the types of situations generated within the EMS tool differed between individuals within the experimental and active control conditions, but not between conscientiousness groups. This offers one possible explanation for the unexpected results seen within this study. A number of other explanations were also discussed in relation to these findings, such as situational flexibility and snack availability and accessibility.

In conclusion, these findings suggested that conscientiousness is a particularly important factor for the stress-unhealthy snacking relationship which should be taken

into account in future research investigating this association. Furthermore, interventions targeting this association should consider a range of factors, such as type of critical cue generated, snack availability, intervention flexibility and personality.

In summary, this thesis has added to the current understanding of the mechanisms through which conscientiousness is translated into better health. Pathways identified included behavioural intention, health behaviours and stress. When compared to individuals low in conscientiousness, individuals high in conscientiousness were found to have stronger behavioural intentions to engage with health behaviours, were found to be more likely to adhere to health behaviour guidelines, had lower blood pressure increases and a faster blood pressure recovery when they appraised a task as being highly stressful, and were found to consume less unhealthy between-meal snacks in response to more stressful days. Therefore, there are a number of mechanisms through which conscientiousness may convey its beneficial effects on health.

6.3 Novelty of the research

The studies included in this thesis have each been innovative in their approach to studying the relationship between conscientiousness, health and longevity. Chapter 2 was novel in a number of ways. To begin with, few studies have examined the relationship between conscientiousness and healthy eating behaviour, in particular fruit and vegetable consumption, with the majority of studies having focussed upon unhealthy eating behaviours (Bogg & Roberts, 2004). Moreover, what was particularly novel about this research was that conscientiousness was assessed at facet level. To date, no other known study has examined behavioural intention as a mediator of the conscientiousness-fruit and vegetable consumption relationship whilst assessing conscientiousness at facet level. This finding is particularly important as it highlighted the importance of self-regulatory processes in the conscientiousness-fruit and vegetable consumption relationship.

Research presented in chapter 3 was innovative in its approach to measuring health behaviours. Within the current body of literature, it is particularly unclear to see whether individuals with higher levels of conscientiousness meet guidelines for health behaviours or whether they simply engage with these behaviours more. Likewise, it is unclear as to whether individuals low in conscientiousness do or do not meet health behaviour guideline targets. Although previous studies may have used health behaviour guidelines as measurements, this was the first study to explicitly state that

conscientiousness can predict guideline adherence, when health behaviours were assessed independently as well as when combined to form a health behaviour guidelines adherence index. In addition, to the best of my knowledge, this is the first study to show that individuals high in conscientiousness are nearly twice as likely to meet four health behaviour guidelines in comparison to those low in conscientiousness.

Study 3 which is discussed in chapter 4 was particularly novel in that very little research has examined the relationship between conscientiousness and stress reactivity in terms of physiology. To date, no other study has examined the effects of the MAST procedure (Smeets et al., 2012) on conscientious groups. Similarly, no other study has compared blood pressure reactivity and recovery in response to a stressful task in conscientious groups. Therefore, the finding that primary appraisals of a stressful task seem to be particularly important for being able to deal with anticipated stress physiologically is entirely novel in itself.

Lastly, study 4 which is described in chapter 5 was original in a number of ways. Firstly, utilisation of online daily diaries to study the conscientiousness-health behaviour relationship is a novel approach, as to date few studies have done so (O'Connor et al., 2015). Additionally, the employment of the sophisticated analytical technique of multilevel modelling is also novel within this field as few studies have employed this methodology (O'Connor et al., 2015). Next, the mechanism of stress exposure as a means through which conscientiousness may convey its desirable influence has been examined in few studies, and even fewer have examined the relationship between conscientiousness, stress exposure and health behaviours. Also, to date no study has used the Volitional Help Sheet to form the basis of an intervention for conscientiousness groups, and thus no study has examined the effectiveness of such tools for these groups. More specifically, no known intervention has targeted the daily hassles-unhealthy between-meal snacking relationship in individuals selected upon their level of conscientiousness. What is more, no study has previously combined all of these factors within one study.

As a result, this thesis presents an interesting advancement towards the understanding of what is currently poorly understood. A number of clear mechanisms have been identified which are of great value for this area of research. As a consequence of this research, there is now a greater understanding of the conscientiousness-health relationship and future directions for research have been brought to attention.

6.4 Limitations

There were a number of shortcomings within this research that require addressing. Here the major limitations of the thesis are discussed.

6.4.1 Measurement of conscientiousness

Within this research conscientiousness was measured via the Chernyshenko Conscientiousness Scales (Green et al., 2015). Although it is possible for a third party to complete the questionnaire, here the questionnaire was used as a self-report tool. Therefore, it is possible that the data collected via this method was open to bias and reliability issues, as self-report techniques have been shown to have more reliability problems than non-self-report measures (Monroe, 2008). However, there is evidence to suggest that using self-report techniques for measuring personality are actually more reliable than ratings from an observer (Chapman et al., 2011). Previous research assessing the relationship between conscientiousness and health behaviours have employed self-report measures (Roberts et al., 2005), therefore, in order to further explore these pre-existing findings, it was necessary to employ the same methods of measurement. In terms of practicality for the researcher and participants, utilising self-report techniques allowed for the burden placed upon participants to be reduced, as third party observer ratings can be more time consuming for the participant, and also allowed for the costs of the research to be kept to a minimum, as employing third party observers can be costly. Most importantly, as this research included individuals with varying levels of conscientiousness, it was deemed necessary to make taking part in the research as un-burdensome as possible in order to attract the participation of individuals with low levels of conscientiousness.

One further limitation of this current thesis was that conscientiousness was only measured at a single time point. However, as the studies included in this thesis were conducted over a fairly short time scale, it was not deemed appropriate to measure conscientiousness at multiple time points. Longitudinal research that follows participants over months and years is desirable in order to assess changes in conscientiousness over time and the effects of such changes on health behaviours, as recent research has highlighted that changes in conscientiousness have important implications for predicting health-related and psychosocial factors (Luo & Roberts, 2015; Segerstom & O'Connor, 2012).

6.4.2 Measurement of health behaviours

A number of health behaviours were assessed via self-report techniques and were thus reliant upon accurate recall and introspective ability. One limitation here is that even if the participant was honest and open about their behaviours, they may have lacked the introspective ability to accurately recall the correct response. This may have particularly been the case for the first two studies (chapters 2 and 3) in which participants were required to recall behaviours practiced over the past seven days. Within the daily diary study (chapter 5), participants reported their behaviours daily, meaning that recall bias ought to have been less problematic for this part of the research.

One other limitation was that the participants were relied upon to understand the questions being delivered. However, detailed information was provided to participants that included clear guidance, for example, for fruit and vegetable portion sizes, for mild, moderate and strenuous activities and for alcohol measures; in order to make participants estimations as accurate as possible. Given that these detailed descriptions were provided, it is arguable that the participants were required to interpret very little. Furthermore, given the nature of the behaviours being assessed it would be particularly difficult to employ any observational measures, as participants would be required to be monitored throughout the day.

Within the 14 day daily diary study (chapter 5) participants were required to report each between-meal snack that they consumed within the study period. Here, the total? fat, saturated fat and sugar content of each snack were analysed. One limitation of this method was that the portion size of each snack was unknown, meaning that calorific content was unable to be calculated. However, given the length of the study, it was deemed that providing portion sizes for numerous snacks over numerous days would be too burdensome for the participants and would lead to a lesser amount of diary entries being accurately completed. Therefore, only the composition of participants daily snacking were discussed and inferred upon.

Lastly, one problem encountered with the measurement of health behaviours arose from the matter that previous research has assessed health behaviours in a range of different ways. For example, eating behaviour has not only been assessed in terms of healthy eating and unhealthy eating, but also in terms of BMI, between-meal snacking, fruit and vegetable consumption and fat consumption (Bogg & Roberts, 2004). As a result, there is some difficulty in interpreting the emerging pattern of findings between

conscientiousness and particular health behaviours. It has been argued that some health behaviours require more attention than others, such as physical activity and unhealthy eating, as there is currently a lesser amount of research assessing these health behaviours in comparison to health behaviours such as smoking and alcohol intake (Bogg & Roberts, 2004), meaning that more research may be required before the precise pattern between conscientiousness and specific health behaviours can be fully understood.

6.4.3 Measurement of health and longevity

Although the overarching aim of this research was to increase physical health and longevity, these factors were not directly measured within this thesis. In order to assess changes in health over time which may predict longevity, longitudinal research is required in which personality and physical health are measured at multiple time points, alongside measurement of possible mediating variables such as stress and behavioural intentions.

Due to the time scale of the research it was not feasible to conduct the required longitudinal studies that would have enabled this relationship to be assessed. However, daily health outcomes were assessed that are known to be predictors of physical health. Similarly, physiological measures such as blood pressure and heart rate were assessed in response to stress, as these factors have also been shown to be associated with physical health. As previous longitudinal research has demonstrated the direction of these relationships, it can be inferred that these daily outcomes and physiological measures can predict better physical health and longevity.

Although cross-sectional 'snap-shot' are useful for determining the underlying pathways that link conscientiousness to health, it is essential that longitudinal research is conducted in order to fully understand this complex relationship. In addition to this, large scale longitudinal studies may be required in order to have the statistical power required to detect such small but clinically relevant effects (Adam & Kumari, 2009). ,

6.4.4 Measurement of stress

Within this thesis, stress was assessed in a number of ways. In the third study described in chapter 4, stress was measured in response to a stress induction protocol named the Maastricht Acute Stress Test (Smeets et al., 2012). Although stress eliciting techniques have a number of advantages, such as replicability and practicality, one

limitation of this methodology is that it is questionable whether the level of stress elicited as a result of this procedure is equivalent to levels of stress typically experienced in real life settings, and consequently, whether the findings of studies using such techniques can be extrapolated to real life scenarios. However, the use of such methods allows for physiological measurements to be taken, which are particularly difficult to gain within naturalistic settings. Due to the nature of stress, which often occurs unexpectedly and at a variety of places and times of the day, it would be extremely costly and burdensome for participants to be required to take multiple measurements at the onset of stress. Furthermore, it was recommended by Roberts and Luo (2015) that future research ought to measure stress via physiological measures, which therefore makes stress inducing protocols more preferable.

Alternative research has however suggested that research has been overly reliant upon laboratory based measurements of stress that have measured stress only at a single time point (O'Connor et al., 2008). The authors discussed that stress ought to be measured at multiple time points to allow for fluctuations within stress to be captured. Within study four, presented in chapter five, stress was assessed via the employment of an online 14 day daily diary. Here participants were permitted to record numerous stressors that they experienced and thus were not constrained to being assessed in relation to a single stressful encounter. However, as previously mentioned, due to the burdensome nature of multiple physiological measurements, only psychological measurements were able to be gained via this methodology. Furthermore, this method was reliant upon self-report and was thus less objective than the physiological measures gained in response to the MAST. Additionally, the daily diary protocol adopted within this study was 'interval-contingent' in methodology, meaning that participants completed the diaries at a specified time which in this case was the evening before bed time. Therefore, participants were relied upon to accurately recall the details of each daily hassle that they had experienced, and thus entries may have been subject to bias. Although it is possible to employ an 'event-contingent' method, in which participants complete the diary entry immediately after the event has occurs, it was felt that this method was too burdensome to the participant given the multiple entries requested and the length of the study.

6.5 Implications

The results of this research have implications for the study of physical health and the conscientiousness-health relationship. It is well understood that there are a vast number of factors that have the capacity to influence health over the life course. It is also acknowledged that that 'multiple causal linkages between personality and disease may be simultaneously operating across long periods of time' (Friedman, 2008, p. 668). Therefore, it is likely that a number of factors will interact with each other over the life course to influence health and longevity. Thus, the identification of robust associations between influencing factors helps to improve our understanding of such interactions. This thesis has contributed to this understanding in the following ways:

1. *Highlighted the importance of studying conscientiousness at facet level.*

   The findings of this research demonstrated that the lower order facets of conscientiousness show differential relationships to measurements of health than to that of total conscientiousness, as well as differential relationships to each other. Here it was highlighted that particular facets are more strongly associated with particular health behaviours than others. Furthermore, it was shown that only particular facets had the ability to predict specific health behaviours. This is important given that that assessing people in terms of such lower order facets may identify people who are at an increased risk. Similarly, there is the possibility for interventions to be based upon the specific qualities of such facets.

2. *Identified behavioural intention as a mediator of the conscientiousness-health behaviour relationship.*

   The theory of planned behaviour variable behavioural intention was shown to be significantly positively associated with conscientiousness and each of its facets. Furthermore, behavioural intention was significantly positively associated with self-reported fruit and vegetable consumption. Mediation analysis demonstrated that behavioural intention mediated the relationship between total conscientiousness, (as well as the facets of industriousness, order, responsibility, virtue) and self-reported fruit and vegetable consumption. This finding has important implications as it highlighted the importance of self-regulatory processes for health. Moreover, it identified a specific factor that can be targeted within interventions.

3. *Provided evidence of the association between conscientiousness and health behaviour guideline adherence.*

   Previous research has demonstrated the relationship between conscientiousness and health behaviours; however it was unclear whether recommended levels of behaviour engagement were being reached in those who are regarded as being highly conscientious. Conscientiousness was found to be significantly positively associated with adherence to a number of health behaviour guidelines, as well as with an overall health behaviour guideline adherence index. This is essential information given that interventions may be based upon the practices of highly conscientious individuals. These results provide further support for the conscientiousness-health behaviour relationship, and provide vital information for understanding this relationship.

4. *Provided further evidence for the relationship between conscientiousness and stress reactivity.*

   Although there is some existing literature linking conscientiousness to stress reactivity, the relationship is not well understood. Here, results revealed that the relationship between conscientiousness and stress reactivity may be a particularly complex one. Conscientiousness group was not found to have a main effect on the psychological measures of appraisal or state anxiety, nor on the physiological measures of blood pressure or heart rate. However, primary appraisals were found to be associated with systolic blood pressure reactivity and recovery in individuals high in conscientiousness, but not within those low in conscientiousness. Therefore, this finding has important implications in that evidence has been provided to suggest that there is a differential effect of reactivity to stress that is associated with level of conscientiousness. Given that stress may be an important target for future interventions, it is imperative that this relationship is well understood. Alongside this, primary appraisal has been identified as being a key variable within this relationship.

5. *Provided further evidence for the relationship between conscientiousness, stress exposure and health behaviours.*

Previous research has demonstrated the relationship between conscientiousness, number of daily hassles experienced and various health behaviours. Results here have provided further support for these associations. Findings indicated that the relationship between number of daily hassles and number of unhealthy between-meal snacks were moderated by conscientiousness, in that individuals scoring low in conscientiousness consumed more unhealthy snacks in response to stress. This is important as it highlights a number of targets for interventions. Firstly, individuals low in conscientiousness are identified as individuals who may be more at risk to the negative effects of stress on health, and are therefore identified as recipients for interventions. Next, stress is identified as a problem for health, and thus stress management interventions may be possible. Lastly, eating behaviour is highlighted as a route through which stress may have a negative impact upon health, and therefore this is highlighted as a health behaviour that people may require assistance with.

6. *Furthered our understanding about intervention suitability and effectiveness.*

   Utilisation of an adapted version of a previously tested intervention delivery tool enabled a number of important factors to be identified for future interventions. Results indicated a greater association between unhealthy between-meal snacking and daily hassles in individuals within the experimental condition when compared to those within the active control condition. Although it cannot be explicitly stated that the process of the active control condition reduced unhealthy snacking, it is possible that it may have had such an effect. One implication of this finding is that it has been highlighted that implementation intentions may be less effective than such alternatives for reducing stress related unhealthy between-meal snacking. Alongside this, it has been highlighted that the type of critical situation generated in implementation intention based interventions may be a possible influencing factor on the effectiveness of these types of intervention.

7. *Application to public health policies*

   Overall, the findings of this research have the potential to impact public health. The above findings have each provided additional information for individuals responsible for promoting population health, forming public health policies and delivering health care, for example, by identifying individuals who may be most vulnerable or by identifying target behaviours for interventions. Therefore, these findings can be seen as a contribution to work aiming to reduce the number of deaths that are attributable to avoidable health problems.

6.6 Future directions

This thesis focussed on exploring under researched explanatory mechanisms of the conscientiousness-health relationship. As a result of these investigations, a number of directions for future research were identified. In addition, within the recent literature alternative approaches to this topic have been proposed that will now be discussed.

Historically, it has been commonly accepted that personality is unalterable; with the misconception that personality is highly inherited (Roberts et al., 2014). Research has in fact demonstrated that conscientiousness related traits are inherited approximately only 40-50 % of the time (Krueger & Johnson, 2008), which therefore suggests that there is a large role to be played by environmental factors (South & Kreuger, 2013). As a result of such misunderstandings, research has mostly focussed upon conscientiousness related behaviours as targets for behaviour change interventions. However, more recently, there is a growing body of research that has suggested that personality itself is changeable (Roberts et al., 2014; Magidson et al., 2014). Empirical evidence has suggested that conscientiousness and its related lower order facets not only change consistently over time, but are also alterable (Roberts et al., 2006; Jackson et al., 2009). Furthermore, such changes are reliable and robust over time are not simply inconsistencies in personality (Roberts & Mroczek, 2008; Roberts et al., 2014). That is to say, consistency and change are not opposite ends of the same spectrum. Therefore, there seems to be scope for problematic personality traits to be modified. By identifying and targeting specific behaviours that underpin problematic personality traits, it is hoped that new and desirable patterns of behaviour will become automatic as a result of changes in personality.

A number of studies have measured personality change over time in individuals who have been recipients of interventions, which have come in the form of psychotherapies and drug therapies (Smith et al., 1980; Piedmont, 2001; Clark et al., 2003; Krasner et al., 2009; Tang et al., 2009). In a study conducted by Piedmont (2001), the personality traits of chronic substance users were monitored over a one year period, whilst they undertook a number of treatments that aimed to improve their coping ability, vocational skills and spiritual development. Results indicated a presence of positive changes in each of the Big Five personality domains when baseline scores were compared to scores post-treatment. This change was equivalent to one-quarter to one-half a standard deviation increase from baseline.

In a similar study, the personalities of individuals with depression were examined whilst they undertook a number of therapies over a of six month period. Findings suggested that scores on neuroticism decreased one-half a standard deviation from baseline to post-intervention (De Fruyt et al., 2006). Therefore, although the primary aims of these studies were not to change personality, they provide evidence that personality is changeable. What is particularly interesting is the magnitude in the change in personality. Within these studies, personality typically changed from one quarter of a standard deviation to one standard deviation across periods of time between six months and one year. According to Roberts et al. (2006), personality can be expected to change around one standard deviation across the life span. It therefore seems that therapeutic interventions may be able to provide changes in personality that is equivalent to many years of natural development. However, it is important to note that these studies were reliant upon self-report measures, and therefore it is desirable for future research to adopt objective measures of personality as well as to measure changes in personality at numerous time points.

Although there is a growing body of evidence suggesting that personality is changeable, few studies have endeavoured to target personality through theoretically informed interventions (Magidson et al., 2014). Moreover, changing personality can be approached in more than one way, and it is not yet understood which approach may be most effective. For example, a ‘top-down’ approach would aim to identify the personality trait itself as the target for intervention, and aim to directly modify the trait, which would subsequently influence behaviour. Meanwhile, a ‘bottom-up’ approach would aim to alter traits by targeting underlying behaviours of the trait, and to make desirable changes in behaviour automatic, which would in turn ultimately impact the

personality trait. Therefore, future studies ought to explore means of increasing conscientiousness via therapeutic techniques in order to further understand the potential effectiveness of specific techniques, as well as to provide further insight into the most appropriate and practical approaches.

Future studies should also assess the effectiveness of behaviour change techniques for increasing beneficial health behaviours in individuals with low levels of conscientiousness. Although much work has been done to assess the success of interventions for improving health behaviours, it may be the case that some are more appropriate and practical for individuals with low levels of conscientiousness than others. Given that individuals low in conscientiousness are not known for their effortful and disciplined personalities, interventions tailored to these subgroups may need to account for such qualities. For examples, interventions that are considered burdensome in terms of time and effort may not be appropriate. Likewise, interventions that require prior preparation and planning may not be the most effective routes to behaviour change.

It may also be the case that interventions that are effective in individuals with moderate or high levels of conscientiousness are not effective in individuals with low levels of conscientiousness. For example, research conducted by Webb et al. (2007) demonstrated that conscientiousness moderated the effectiveness of an implementation intention based intervention for improving class attendance, with the intervention having a larger impact on individuals with low or moderate levels of conscientiousness than those who were high in conscientiousness. Although in this particular case the intervention was more effective in individuals with low levels of conscientiousness, it demonstrates that level of conscientiousness can influence intervention appropriateness and/or success.

One other direction for future research is to investigate the interactive effects of factors that are known to be related to conscientiousness, health and longevity. Within the current literature, a range of relationships between social and environmental factors, personality and health have been established (Bogg & Roberts, 2004); however it is not well recognised how these factors interact with each other to influence longevity. The relations between factors appears to be particularly complex, for example, Luo and Roberts (2015) demonstrated within one study that stress mediated the association between conscientiousness and health, changes in conscientiousness were associated with changes in stress, increases in conscientiousness were associated

with changes in stress and conscientiousness change was associated with changes in health. Although this research was longitudinal in its design, further longitudinal research that includes the examination of multiple factors know to be associated with conscientiousness, health and longevity is required to be conducted over the lifespan in order to disentangle the various pathways that require further understanding. The requirement for such approaches has been supported by Friedman (2008) who has argued that 'multiple causal linkages between personality and disease may be simultaneously operating across long periods of time' (p. 668), and by Segerstrom and O'Connor (2012) who suggested that longitudinal studies need to include examination of multiple predictors and outcomes. In addition to this, future studies should aim to establish a robust pattern between facets of conscientiousness and particular health behaviours, as it is still unclear as to which facets are most highly associated with which health behaviours. In conclusion, future research should aim to test numerous pathways simultaneously across the life course.

6.7 Conclusions

The relationship between conscientiousness and health behaviours was further supported by findings reported here, with additional evidence provided to demonstrate that individuals high in conscientiousness are more likely to adhere to health behaviour guidelines. Behavioural intention was identified as one pathway through which conscientiousness may be translated in to actual behaviour, and was therefore identified as a target for future interventions. Next, stress was established as an important factor in the conscientiousness-health relationship, with differences observed between individuals high and low in conscientiousness. In terms of stress reactivity, primary appraisal was highlighted as being of importance for the conscientiousness-stress association, and may ultimately influence health via physiological reactivity. Daily stress was also shown to be associated with the health behaviour unhealthy between meal snacking, and this association that was shown to be moderated by conscientiousness whereby individuals low in conscientiousness consumed a greater number of unhealthy between-meal snacks on more stressful days. What is more, implementation intention based interventions may not be the most appropriate techniques for changing behaviour in individuals low in conscientiousness. A number of directions for future research were identified which may provide further understanding and/or identify alternative mechanisms through which conscientiousness may influence

health and longevity; which may in turn inform effective interventions for individuals with low levels of conscientiousness.

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8 APPENDICES

8.1 *Appendix A* Study 1 – Study information sheet and consent form

CONSCIENTIOUSNESS AND HEALTH

NOVEMBER 2009

- Questionnaire -

Thank you participating in our study sponsored by the U.S. National Institute on Aging of the National Institutes of Health (NIH).

Please read this consent agreement carefully. You must be 18 years old or older to participate.

Purpose of the research: This research is being conducted by Professor Brent Roberts, University of Illinois within the Department of Psychology. The purpose of this research is to test several hypotheses concerning age differences in personality traits across the life span and to test the relationship between personality and health-related behaviors and how this relationship changes with age. Please note that health measures are not intended to be used for diagnostic purposes. We are conducting a longitudinal study, which means we will be contacting you again in three years to complete a similar set of questions.

What you will do in this study: You will be asked to complete a demographic questionnaire, several personality questionnaires, several health-behavior checklists, and several questionnaires about your experiences in social roles. Your participation will take approximately 1 hour of your time.

Risks: We believe that the primary risk involved in the study is that several of the questions may be of a personal, very sensitive nature and may make you feel uncomfortable. However, you have the option to skip any questions should you choose and know that Knowledge Networks applies information technology security and will only supply data to the researcher not any personal information pertaining to you as an individual.

Compensation: Although you may omit answering individual questions, individuals who do not complete all of the questionnaires will not be reimbursed. You will be compensated $30 in cash equivalent incentives for completing the questionnaires.

Voluntary Withdrawal: Your participation in this study is completely voluntary, and you may withdraw from the study at any time without penalty. You are under no obligation to complete the questionnaires. You may refuse to answer specific questions, and you may discontinue your participation at any time. The decision to participate, decline or withdraw from this study will have no effect on your status at, or future relations with the University of Illinois.

Confidentiality: Your participation in this study will remain confidential, and your identity will not be stored with your data at the University of Illinois. Your responses will be assigned an identification number by the staff at Knowledge Networks and then the data with just the identification number will be sent to our offices. Our research staff at the University of Illinois will never see your name or other identifying information when we examine the data sent to us by Knowledge Networks. Furthermore, the data we receive from Knowledge Networks will kept on password-protected computers in locked rooms in the researcher's offices.

Further information: If you have questions about this study, please contact Brent Roberts, Department of Psychology, University of Illinois, Champaign, IL 61820. Email: broberts@illinois.edu; phone 333-2644,

Who to contact about your rights in this study: If you have any concerns about this study or your experience as a participant, you may contact the Institutional Review Board (IRB) at UIUC at (217) 333-2670 (collect calls will be accepted if you state you are a study participant) Email: irb@uiuc.edu

Agreement: The purpose and nature of this research have been sufficiently explained and I signify that I am 18 years of age or older and agree to participate in this study. I understand that I am free to withdraw at any time without incurring any penalty. I have read and understand this consent form. I understand that by clicking this proxy I consent to voluntarily participate in this study.

8.2 *Appendix B* Study 2 – Participant recruitment poster

Institute of Psychological Science
Health and Social Psychology Laboratory

UNIVERSITY OF LEEDS

Participants Required for Study on Personality & Health Behaviours

£50 Prize Draw

To Participate You Must Be:

- **Over 18 years old**
- **Speak fluent English**
- **Generally be in good health**

What will I have to do?

You will be asked to complete an online questionnaire. Within this you will be asked about your health behaviours (e.g. smoking and physical activity behaviours) and your personality. The questionnaire will take approximately ten minutes to complete. Following this, participants who meet our inclusion criteria may be invited to take part in the second part of this research, which will take place in the Health and Social Psychology Laboratories, University of Leeds.

For more information please contact Antonia Wilson: pschandp@leeds.ac.uk

This research has been approved by the IPS ethics committee (Ethics reference number: 14-0016). This research is supervised by Professor Daryl O'Connor, Institute of Psychological Sciences, d.b.o'connor@leeds.ac.uk

8.3 *Appendix C* Study 2 – Invitation to participate email

Dear all,

We would like to invite you to take part in a study investigating health and personality.

What will you have to do?

You will be asked to complete an online questionnaire. Within this you will be asked about your health behaviours (e.g. smoking and physical activity) and your personality. The questionnaire will take approximately ten minutes to complete. On completion of this questionnaire, you will be entered into a £50 prize draw. Participants must be over 18 years old, speak fluent English and generally be in good health.

Please find the link to complete the questionnaire below:

www.psyc.leeds.ac.uk/q/healthandpersonality

Following this, participants who meet our inclusion criteria may be invited to take part in the second part of the study (there is no obligation to partake).Within this, you would be required to visit the Health and Social Psychology Laboratories, at the University of Leeds on one occasion for approximately one hour; as well as completing a short online diary each evening for 14 days, that would take you no longer than ten minutes to complete. On completion of this you would receive a £15 love2shop voucher to compensate your time.

If you have any questions, please do not hesitate to contact Antonia Wilson at pschandp@leeds.ac.uk, or the project supervisor, Professor Daryl O'Connor at d.b.o'connor@leeds.ac.uk.

Best wishes

Antonia Wilson

This project has been reviewed and approved by the Institute of Psychological Sciences Research Ethics Committee (ref no: 14-0016; date approved: 21-Jan-2014).

8.4 *Appendix D* Study 2 – The Chernyshenko Conscientiousness Scales

Please indicate how much you agree or disagree with each statement.

	Disagree strongly 1	Disagree somewhat 2	Agree somewhat 3	Agree strongly 4
Being neat is not exactly my strength.				
Organization is a key component of most things I do.				
I need a neat environment in order to work well.				
I become annoyed when things around me are disorganized.				
For me, being organized is unimportant.				
Half of the time I do not put things in their proper place.				
Most of the time my room is in complete disarray.				
Every item in my room and on my desk has its own designated place.				
I frequently forget to put things back in their proper place.				
I hate when people are sloppy.				
If I could get away with it, I would not pay taxes.				
I would lie without hesitation if it serves my purpose.				
I could be insincere and dishonest if the situation required me to do so.				
If I find money laying around, I'll keep it to myself.				
If a cashier forgot to charge me for an item I would tell him/her.				
I would rather get a bad grade than copy someone else's homework and turn it in as my own.				
It bothers me when people cheat on their taxes.				
If I accidentally scratched a parked car, I would try to find the owner to pay for the repairs.				
I firmly believe that under no circumstances it is okay to lie.				

The people who know me best would say that I am honest.				
I have the highest respect for authorities and assist them whenever I can.				
People respect authority more than they should.				
Even if I knew how to get around the rules without breaking them, I would not do it.				
I believe that people should be allowed to take drugs, as long as it doesn't affect others.				
I support long-established rules and traditions.				
People who resist authority should be severely punished.				
When I was in school, I used to break rules quite regularly.				
In my opinion, all laws should be strictly enforced.				
In my opinion, censorship slows down the progress.				
When working with others I am the one who makes sure that rules are observed.				
I often rush into action without thinking about potential consequences.				
I rarely jump into something without first thinking about it.				
I am known to make quick, hot-headed decisions.				
I do not take unnecessary risks.				
I am easily talked into doing silly things.				
My friends say I am predictable.				
I get into trouble because I act on impulses rather than on thoughts.				
I am careful with what I say to others.				
I dislike being around impulsive people.				
Even under time pressure, I would rather take my time to think about my answer than to say the first thing that comes to mind.				
I carry out my obligations to the best of my ability.				

I often feel responsible for making sure that all group project assignments are completed.				
I go out of my way to keep my promises.				
Sometimes it is too much of a bother to do exactly what is Promised.				
I would gladly spend some of my leisure time trying to improve my community.				
If I am running late to an appointment, I may decide not to go at all.				
I am usually not the most responsible group member, but I will not shirk on my duties either.				
If I am running late, I try to call ahead to notify those who are waiting for me.				
When I make mistakes I often blame others.				
I have a reputation for being late for almost every meeting or event.				
I have high standards and work toward them				
I go above and beyond what is required.				
I do not work as hard as the majority of people around me.				
I invest little effort into my work.				
I demand the highest quality in everything I do.				
I try to be the best at anything I do.				
I make every effort to do more than what is expected of me.				
I do what is required, but rarely anything more.				
Setting goals and achieving them is not very important to me.				
Getting average grades is enough for me				

8.5 Appendix E Study 2 – Health and Diet Questionnaire

About You

1. Age: 2. Sex: Male Female

3. Please state your ethnicity:

4. Please state your occupation:

5. Please state the highest level of education that you have reached:

GCSE A-level Undergraduate degree Postgraduate degree

6. Please give your height (feet/Inches): 5. Weight (stone/pound):

Your Health

7. During a typical 7-Day period (a week) How many of the following drinks do you drink?

How many pints of beer/lager/cider?

How many measures of spirits? (1 = single shot, 2 = double shot)

How many glasses of wine? (Standard glass = 175ml)

8. Do you smoke?
Yes No

If yes, how many cigarettes do you smoke a day?

9. On a typical night, how many hours do you sleep for? (Hours/minutes)

10. On a typical night, how well do you sleep last?

Not at all well Extremely well

1 2 3 4 5 6 7

11. On a typical night, how long does it take you to fall asleep after lights out? (Hours/minutes)

12. During a typical 7-Day period (a week), how many times on average do you do the following kinds of exercise?

Strenuous exercise (heart beats rapidly) *e.g., running, hockey, football, squash, basketball, judo, roller skating, vigorous swimming, long distance bicycling

Number of times

How much time do you usually spend doing these strenuous activities on one of those days?

Hours/Minutes per day

Moderate exercise (not exhausting) *e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming

Number of times

How much time do you usually spend doing these moderate activities on one of those days?

Hours/Minutes per day

Mild exercise (minimal effort) *e.g., yoga, archery, fishing, bowling, golf, easy walking

Number of times

How much time do you usually spend doing these mild activities on one of those days?

Hours/Minutes per day

This is a guideline to indicate portion size of fruit and vegetables, to help you fill in the questionnaire. You will be asked how many portions of fruit and vegetables you eat each day, please include fresh, canned, frozen, or dried fruit and vegetables. Adult portion size examples are approximately equivalent to 80 grams in weight. Dried fruit portion sizes are approximately equivalent to 30 grams in weight. Please count juice as only one portion a day, no matter how much you drink.

Examples of portions of fruit are one medium apple, one medium banana, two kiwi fruit, two plums, half a large grapefruit, nine strawberries, one orange, two satsumas, three dried apricots, one tablespoon of raisins, or a 150ml glass of 100% juice (fruit or vegetable juice).

Examples of portions of vegetables are three heaped tablespoons of cooked carrots, three heaped tablespoons of beans, three heaped tablespoons of frozen mixed vegetables, two spears of brocolli, eight sprouts, three heaped tablespoons of cabbage, three sticks of celery, eight florets of cauliflower, one medium onion, half a pepper, six baby sweetcorn, one corn on the cob, one medium tomato or seven cherry tomatoes, five spears of asparagus, one cereal bowl of mixed leaves/lettuce, a two-inch piece of

cucumber. Please count beans and other pulses (such as kidney beans) as only one portion a day no matter how much you eat.

13. On average, how many portions of fruit do you eat a day?

14. On average, how many portions of vegetables do you eat a day?

15. On average, how many unhealthy snacks do you eat a day?

15 Are you currently on a diet?

Yes No

8.6 *Appendix F* Study 3 – Study information sheet

You are invited to take part in a study that is being conducted for a PhD. Before you decide whether or not you wish to take part it is important for you to understand why the study is being carried out and what it will involve. This sheet has been designed to give you enough information about the study in order to allow you to make an informed decision about participation. Please take time to read the following information carefully and discuss it with others if you wish. Please ask if anything is unclear or you would like more information. The study will be carried out under the supervision of Professor Daryl O'Connor and Professor Rebecca Lawton, University of Leeds. The study is subject to ethical guidelines set out by the British Psychological Society and has been ethically approved by the Faculty Board of Ethics at the University of Leeds.

What is the purpose of this study?

This project will aim to investigate whether people with different personalities differ in their psychological and physical responses to stress, and it will also examine what factors influence this response. Furthermore, the project will investigate the effects of personality on health behaviours. Participants will be required to visit the health and social laboratories at the University of Leeds on one occasion, alongside completing a short daily diary for 14 days.

Study procedure

There are six steps involved in this study. First you will be asked to sign an informed consent form. Second, we will measure your blood pressure and heart rate using a blood pressure monitor. You will then be asked to sit and relax in a testing cubicle, where you will watch a short PowerPoint presentation about the upcoming task. Third, you will be asked to fill in a short questionnaire measuring your thoughts and feelings about the upcoming task. Fourth, you will complete the challenging task which will not last for more than ten minutes. Immediately following the task you will have blood pressure and heart rate measured, and will be asked to complete another short questionnaire. After resting for 5 minutes, your blood pressure and heart rate will be measured once again. Fifth, you will be provided with some strategies to support you to eat more healthily over the next two weeks. Sixth, after being instructed how to complete the diary over the next two weeks, you will be free to leave the laboratory.

Do I have to take part?

Participation is completely voluntary and it is entirely your decision whether you wish to take part. If you decide to participate you can still withdraw from the study at any time by telling the researcher that you no longer wish to continue. No questions will be asked about your decision

What are the possible disadvantages and risks of taking part?

It may be inconvenient for you to give up your time, and to follow the task guidelines. There is a chance that this study may cause some physical discomfort and may cause you to feel stressed. You are free to stop at any time should you feel upset or distressed, and if the researcher feels that you are overly distressed by the study they will also ask

to end the study. If you feel any distress or negative emotions after the study we would recommend you to contact the researcher.

What are the possible benefits of taking part?

Whilst there are no immediate benefits, the findings from the study will add to our understanding of the relationship between personality and health and wellbeing. Also the findings might help develop important health interventions in the future.

Will I receive anything for taking part in the study?

You will be compensated with a £15 Love2Shop voucher for your participation.

Recruitment Procedure

In order for you to participate in this study you will need to sign a consent form. The study records identifying you and all the information that is collected about you during the course of the research will be kept strictly confidential. Participation in this study is voluntary. You have the right to withdraw from the study within 7 days of your participation. Any data that you have provided will then be discarded. Once all of the study data has been collected and analysed you will be de-briefed about the study in more detail if you wish.

Exclusion criteria

Unfortunately not everyone is eligible to take part in the study. If you have a history of diabetes, hepatic, renal, pulmonary, digestive, haematological, neurological, cardiovascular, thyroidal, hormonal or psychiatric diseases, circulatory problems, chest pain, high blood pressure, Reynaud's syndrome, chronic pain conditions, recent serious injuries or skin conditions (e.g. eczema) on the hands or arms, you may not be able to participate in this study. Alongside this, all participants are required to speak fluent English.

If you have any questions or would like to volunteer to take part in this study, please contact:

Antonia Wilson
E-mail: pschandp@leeds.ac.uk
University of Leeds

Professor Daryl O'Connor
E-mail: D.B.O'Connor@leeds.ac.uk
University of Leeds

Professor Rebecca Lawton
E-mail: R.J.Lawton@leeds.ac.uk
University of Leeds

8.7 *Appendix G* Study 3 – Appraisal items: original items, pre-MAST appraisal items and post-MAST appraisal items

Original Item	Pre-MAST	Post-MAST
How threatening do you expect the upcoming task to be?	How threatening do you think the task will be?	How threatening did you find the task to be?
How demanding do you think the upcoming task will be?	How demanding do you think the task will be?	How demanding was the task?
How stressful do you expect the upcoming task to be?	How stressful do you think the task will be?	How stressful did you find the task to be?
To what extent do you think you will need to exert yourself to deal with the task?	To what extent do you think you will need to exert yourself to deal with the stress?	To what extent did you need to exert yourself to deal with the stress?
How much effort (mental or physical) do you think the situation will require you to expend?	How much effort (mental or physical) do you think the situation will require you to expend?	How much effort (mental or physical) did the situation require you to expend?
How well do you think you can manage the demands imposed on you by this task?	How well do you think you can manage the demands imposed on you by the task?	How well did you manage the demands imposed on you by the task?
How able are you to cope with this task?	How able do you think you are you to cope with the task?	How able were you to cope with the task?
How well do you think you will perform on this task?	How well do you think you will perform on the task?	How well did you perform in dealing with the task?

Appendix H Study 3 – State anxiety inventory

A number of statements which people have used to describe themselves are given below. Read each statement and then circle the most appropriate number for each statement which indicates how *you* feel right now, at this moment.

There are no right or wrong answers. Do not spend too much time on any one statement but give the answer which seems to describe your present feelings best.

	Not at all	Somewhat	Moderately	Very Much
1. I feel calm	1	2	3	4
2. I am tense	1	2	3	4
3. I feel upset	1	2	3	4
4. I am relaxed	1	2	3	4
5. I feel content	1	2	3	4
6. I am worried	1	2	3	4

8.8 *Appendix I* Study 4 – Active Control Condition Eating Management Support tool

EATING HEALTHIER

It is well established that when you are in certain situations, or experience particular feelings, you're more likely to eat high fat and sugar snacks between meals (e.g., to eat chocolate, crisps, cakes) and are less likely to eat fruit and vegetables. People who do not maintain a balanced diet, including eating a low fat diet and five portions of fruit and vegetables a day are likely to be at increased risk of developing heart disease and cancer as they get older. Therefore, we want you to PLAN how you will eat more healthy snacks when you are in these situations, or are subject to these feelings.

What could these situations or feelings be? Although these will be different for each person, some of the most popular reasons people eat high fat and sugar snacks between meals are because they are stressed, because they are with friends, family, classmates or are alone, because they are chatting, watching television, studying or relaxing, or are hungry, feeling bored, socialising or because they are eating for enjoyment.

EATING HEALTHIER

STEP 1: In the box below (left hand column), please briefly describe UP TO FIVE situations in which you usually eat unhealthy snacks (such as chocolate, crisps, cakes).

STEP 2: For EACH of these situations, please choose a healthy snack alternative you could eat. Remember to pick a snack that you really like and that would be usually available in each particular situation. Once chosen please enter it in the right hand column.

SITUATIONS WHEN I EAT SNACKS	HEALTHY SNACK CHOICES
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.

Appendix J Study 4 – Experimental Condition Eating Management Support tool

EATING HEALTHIER

It is well established that when you are in certain situations, or experience particular feelings, you're more likely to eat high fat and sugar snacks between meals (e.g., to eat chocolate, crisps, cakes) and are less likely to eat fruit and vegetables. People who do not maintain a balanced diet, including eating a low fat diet and five portions of fruit and vegetables a day are likely to be at increased risk of developing heart disease and cancer as they get older. Therefore, we want you to PLAN how you will eat more healthy snacks when you are in these situations, or are subject to these feelings.

What could these situations or feelings be? Although these will be different for each person, some of the most popular reasons people eat high fat and sugar snacks between meals are because they are stressed, because they are with friends, family, classmates or are alone, because they are chatting, watching television, studying or relaxing, or are hungry, feeling bored, socialising or because they are eating for enjoyment.

Research shows that if people can identify situations where they eat unhealthy snacks and then LINK them with ways of eating healthy alternatives they will be more likely to maintain a balanced diet.

EATING HEALTHIER

STEP 1: In the box below (left hand column), please briefly describe UP TO FIVE situations in which you usually eat unhealthy snacks (such as chocolate, crisps, cakes).

STEP 2: For EACH of these situations, please choose a healthy snack alternative you could eat. Remember to pick a snack that you really like and that would be usually available in each particular situation. Once chosen please enter it in the right hand column.

STEP 3: Research has shown that these plans work best when you picture the specific situation in your mind and LINK each situation with your healthy snack choice. Therefore, please i) DRAW a line linking each 'situation' and 'healthy snack choice'; ii) THINK ABOUT yourself acting out each of your plans to eat healthier when you are in these situations.

SITUATIONS WHEN I EAT SNACKS	HEALTHY SNACK CHOICES
1.	1.
2.	2.
3.	3.
4.	4.
5.	5.

8.9 *Appendix K* Study 4 – Participant de-briefing sheet

Thank you for participating in this research. Now the study is complete, we can explain to you the purpose and details of the research.

Purpose of the research

There is much evidence supporting the claim that individuals with more conscientious personalities live longer than those with less conscientious personalities. It is demonstrated that more conscientious individuals often engage with more beneficial health behaviours (e.g. healthy eating, physical activity), and are less likely to engage with damaging health behaviours (e.g. smoking, unhealthy eating, excessive alcohol consumption). However, other factors have been suggested to contribute to increased longevity in more conscientious individuals. The first that has been suggested is stress. More conscientious individuals may experience less stress, or cope with stress better when they do experience it. Alternatively, it has been suggested that more conscientious individuals have stronger intentions to be healthy, and it is this planning to be healthy that has a positive effect on their health, and therefore reduces their mortality rate.

This study had two aims. The first was to examine whether individuals with different levels of conscientious personalities responded differently, psychologically and physiologically, to stress. This was done by measuring your blood pressure, heart rate and anxiety levels in relation to the challenging task.

Before the task you were told that you would be video-recorded whilst undergoing the stress test for later facial expression analysis. No video-recording actually took place and no analysis of your performance will occur. The impression of being recorded was included to increase the feeling of being evaluated by others, which has been to shown to enhance how stressful a situation is. You were also informed that the duration of the ice water and mental arithmetic trials was randomly chosen by the computer. This was to increase the unpredictability and uncontrollability of the stressful situation, when in fact the timings were fixed by the researcher.

The second aim was to examine whether individuals with different levels of conscientious personalities responded differently to an intervention to decrease unhealthy snacking. Participants were allocated to one of two groups. The first group completed the intervention to decrease unhealthy snacks; the second group simply listed healthy and unhealthy snacks (this group will be used as a control). Using the diary records, we will compare whether or not the intervention was most useful to individuals scoring low or high on levels of conscientiousness.

Once all the data is analysed and collated, a summary of the findings will be made available to you on request. If you wish to receive a summary of results please send a

request to the email address provided below. Please note the summary may take up to 18 months to complete.

Giving Feedback

People react differently after being in studies like this one. We hope that you liked taking part in this study. But we also want to hear about other responses you may have. Please let us know any thoughts or feelings you have about the study. Honest feedback from you will help us learn. It also gives us a chance to correct any misperceptions or explain parts of the study that may still be confusing.

If you are or become upset as a result of joining this study

Most importantly, if you feel upset or distressed by something that happened, or by what you think this might mean, it is very important that you call Professor Daryl O'Connor on 0113 343 5727 or contact via e-mail at D.B.O'Connor@leeds.ac.uk. Alternatively you may wish to contact Professor Rebecca Lawton on 0113 343 5715 or via email at R.J.Lawton@leeds.ac.uk . We want to do everything we can to ease any discomfort and to help you manage this safely.

If you have any further questions feel free to ask now, or contact me using the details provided below.

Thank You

Antonia Wilson
Institute of Psychological Sciences
University of Leeds
Leeds
LS2 9JT
Email: pschandp@leeds.ac.uk
Phone: 0113 343 2275